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كلية الإقتصاد والعلوم الإدارية
قسم إدارة الأعمال

"The Evaluation of Green Manufacturing Strategies Adopted by ISO14000 Certificate Holders in Jordan"



إشراف

الدكتور يزن خالد المقدادي

إعداد الطالبة

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(الايزو ١٤٠٠٠) في الأردن"

The Evaluation of Green Manufacturing Strategies adopted by ISO 14000 Certificate Holders in Jordan

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بكالوريوس نظم معلومات ادارية،جامعة اليرموك ٢٠١١م

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بسم الله الرحمن الرحيم

الشكر والتقدير

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Abstract:

The aim of this study is to identify the taxonomies of green manufacturing strategies for the manufacturing firms that adopt ISO14001 in Jordan.

There are seventh main objectives of this research; Using the literature to operationally define the Key Performance Indicators, Green Actions, and Performance Indicators, Identifying the Key performance indicators that the manufacturing firms seeks to realize, Identifying the green operations actions made by the manufacturing organizations realized ISO 14001 standards in Jordan, Identifying the Performance indicators realized by the manufacturing organizations realized ISO 14001 standards in Jordan, Clustering the manufacturing organization according to Key Performance Indicators in Jordan, Identifying the significant actions made by the different clusters of manufacturing organization realized ISO 14001 standards in Jordan, Identifying the significant performance indicators realized by each manufacturing firm cluster.

A tentative list of key performance indicators, green operation actions, and performance indicators was developed based on a thorough and detailed analysis of the pertinent literature. The survey questionnaire contained 103 items, developed based on the literature and interviews with three industry experts, specifically quality assurance officers and ISO14001 representatives, and five academics. A total of 27 questionnaires were mailed out, sent via fax ad via personal interviews. All questionnaires returned.

The research used K-mean clustering analysis to identify green manufacturing strategic groups. Also the research used special ranking method to make reasonable and unified scale, the research identify these green manufacturing strategic groups by key performance indicators.

The analysis results; there are three significant clusters of green manufacturing strategies according to key performance Indicators (environmental, Operational, and Economic (financial)), these clusters are: agile environment, care-taker environment and lean environment.

Also, there are two consistent strategic patterns of green manufacturing strategies in Jordanian: Agile and lean environment taxonomies. According to agile environment strategic group, it intended to realize all key performance indicators in a high level, and adopted green actions from the majority of different categories, and realized high level of performance in all performance indicators. While lean environment intended to seek two key performance indicators; environmental and economic (financial) and adopted a different set of green actions in a high level, then it realized performance in these two areas in a high level. Care-taker environment didn't have a clear strategic pattern.

Key words: ISO14001, Environmental Management System, green manufacturing strategy, key performance indicators, green operation actions, performance indicators.

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Chapter one: General Framework

Introduction:

The main purpose of this chapter is to introduce the research idea in brief manner, and provide the interested readers with general overview of the study. Respectively the following titles were discussed in this chapter; research problem, research objectives and question, research Gaps and contributions, and research structure.

1-1 Research Problem

Today's business, regardless the organizational contingency factors such as activity, technologies, structure and size, business enterprises have some effect or impact on the ecological environment (McNaughton, 1983). Whereas there are many tools that permits companies to identify and addresses their particular impact on environment. Environmental issues should be considered in organizations as other management issues. Environmental management system (EMS) is the most commonly adopted system, include the international standard ISO 14000 family which launched by the international organization for standardization (ISO) (Diakaki et al., 2006).

Recently, a higher priority gained to the environmental issues by many different industries owners' and businesses superintended due to the environmental regulations as well as the market pressures and environmental associations. Manufactures more became interested in green products and clean production, where it become more important. In order to adopt sound environmental practices, the answer was ISO 14000 family series which become essential requirement for most manufacturers around the worldwide (Ganesh & Rajendran, 2008).

During the past ten years there has been a rapid growth in concern about environmental issues around the world. Environmental management systems (EMS) have prospered, and specifically in the international certification standard ISO 14001. The number of certificates has passed from 17,476 in 2000 to 185,899 in 2009 representing a percentage increase of 963.74 percent (Femenias, *et al*, 2013). This generate a question about the different strategies adopted by ISO14001 holders and to what extent these strategies are effective and efficient, since the standard is not concern about specific strategies to be followed, so this research focuses on identifying the effective green manufacturing strategies adopted by ISO 14001 holders in Jordan according to the environmental impact.

1-2 Research Objectives

1- Using the literature to operationally define the Key Performance Indicators, Green Actions, and Performance Indicators.
2- Identifying the Key performance indicators that the manufacturing firms seek to realize.
3- Identifying the green operations actions made by the manufacturing organizations realized ISO 14001 standards in Jordan.
4- Identifying the Performance indicators realized by the manufacturing organizations realized ISO 14001 standards in Jordan.
5- Clustering the manufacturing organization according to Key Performance Indicators in Jordan.
6- Identifying the significant actions made by the different clusters of manufacturing organization realized ISO 14001 standards in Jordan.

7- Identifying the significant performance indicators realized by each manufacturing firm cluster.

1-3 Research Question

What are the taxonomies of green manufacturing strategies adopted by the ISO 2 14001 holders in Jordan?

1-4 Originality of this research, Research Gaps And Contributions

This is the first study in the Middle East that addressed the green manufacturing strategic patterns in consideration, the methodology used in this research is unique, since the researcher used K-mean clustering analysis, the previous studies have not addressed the significant actions and performance indicators in details since the previous studies addressed significant actions in terms of inter and intra green actions , the previous studies have not clustered or grouped the manufacturing firms based on KPIs, and the titles of green strategic patterns are unique, which have not addressed by the previous studies.

1-5 Research Structure

Chapter1: General framework

Chapter2: Overview of ISO 14001 certificates holders in Jordan

Chapter3: A conceptual framework

Chapter4: Literature review of ISO 14001 studies

Chapter5: Research methodology

Chapter6: Data analysis and findings

Chapter7: Discussion, conclusions and applications

Chapter 2: Overview of ISO 14001 Certificates Holders in Jordan

2-1 Introduction:

This chapter provides an overview about Jordan demographic properties. Also, this chapter presents general statistics about Jordan and its environment, Jordanian industrial sectors, finally, show statistical characteristics about ISO14000 family series in Jordan.

2-2 Overview about Jordan

The Hashemite Kingdom of Jordan is an Arab kingdom in West Asia, on the East Bank of the Jordan River. Jordan is bordered by Saudi Arabia on the east and south-east, Syria on the north, Iraq on the north-east, and the West Bank and Israel on the west.

The system of government in Jordan is a constitutional hereditary monarchy, where in the executive power lies with the King Abdullah II. Jordan is divided into 12 provinces called Governorates; Amman, Balqa, zarqa, Madaba, Irbid, Jarash,Mafraq, Ajlun, Karak, Ma'an,Tafiela, Aqaba. Amman is the capital city of the Kingdom of Jordan and cover an area of 7579 Km2. According to the 2013 census; the country has an approximate population of 6,530,000 and estimated growth rate of population 2.2%. And covering an area of 88794 km2. (Department of statistics. 2013).

Islam is the official and the dominant religion of Jordan. As well the official language of Jordan is Arabic. In addition the Jordanian dinar is the official currency of Jordan; the dinar is divided into 1000 fils.

2-3 Jordan and the environment: Environmental surveys:

The following table (2-1) shows gas emissions from the energy usage in Different sectors in Jordan, it can be seen that are increased significantly over time, and it has a negative impact on environment (Department of statistics. 2011).

Table (2-1): Estimated Quantities of Gas Emissions from the Energy Usage in Different Sectors((household, industrial, transportation, commercial, transformation and agricultural)),2002-2009 (Metric Ton/Year) (Department of statistics. 2011).

Gas	2002	2003	2004	2005	2006	2007	2008	2009	Gas
NO_x	108.9	113.7	118.2	122.2	127.0	130.1	135.0	140.5	Nitrogen oxides
CO	433.7	457.7	483.3	509.5	537.4	566.9	598.0	630.5	Carbon monoxide
NMVOC	44.1	46.2	48.7	50.9	53.3	55.9	58.6	61.5	Volatile Organic Compounds
Methane	2.2	2.3	2.4	2.5	2.7	2.9	3.1	3.2	Methane
N_2O	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	Nitrous oxide
CO_2	17742.2	18600.0	19493.0	20107.0	20766.9	20712.4	21387.7	12996.2	Carbon dioxide

Table (2-2) contains the percentage of electrical energy consumption in the industrial sector over the period (2005-2009), and figure (2-1) illustrates this graphically. It shows that Consumption of the industrial sector considered the second largest consumption relative to other sectors (Department of statistics. 2011).

Table (2-2): Percentage of Electrical energy used by industrial sector, 2005-2009 (Giga Watt/ Hour) (Department of statistics. 2011).

year	Household	Industrial	commercial	Water pumping	Streets lighting	Others(include the consume of hospital, charities, Broadcasting and TV)
2005	34.3	30.5	15.1	14.9	2.8	2.3
2006	35.7	28.8	15.8	14.6	2.7	2.4
2007	38.0	27.7	16.7	15.1	2.6	0.0
2008	38.7	27.2	16.7	14.9	2.5	0.0
2009	40.9	25.1	16.6	14.8	2.6	0.0

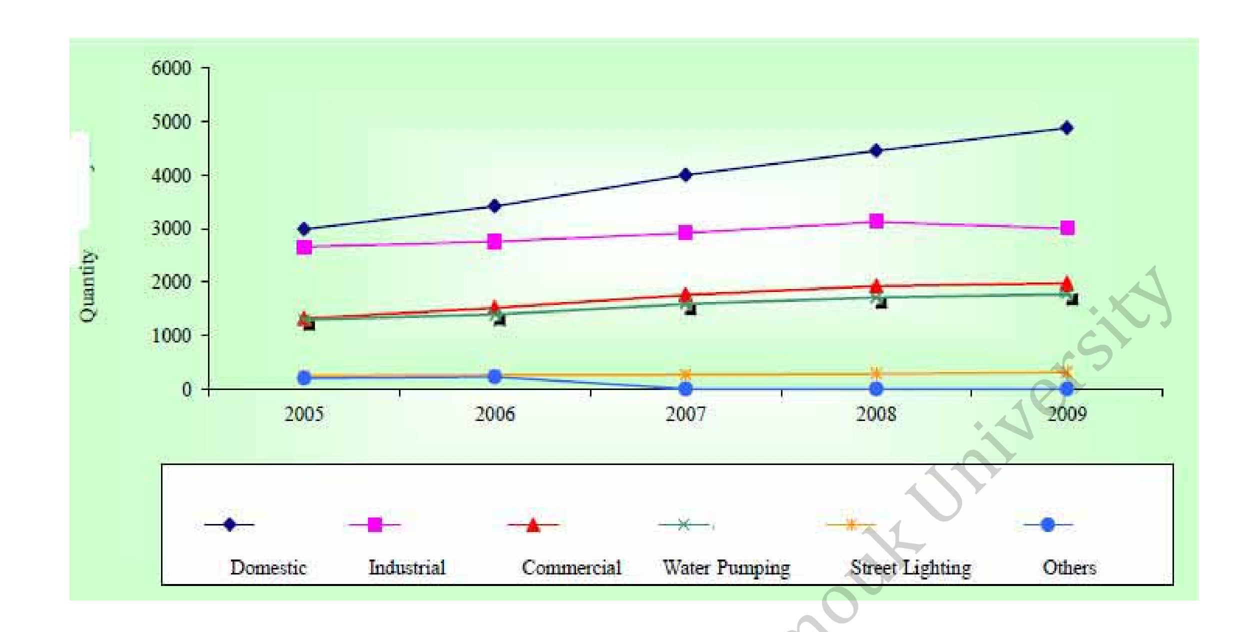


Figure (2-1): electrical energy used by sectors, 2005-2009 (GWH)

Industrial firms' affect natural environment in a negative way (e.g. environmental pollution and high level consumption of various energy sources… etc). This one of the reasons for selecting the Jordanian industrial companies as a sample study.

2-4 Jordanian industrial sectors

- **Main industrial indicators**

  The Hashemite Kingdom of Jordan characterized by a strategic location and in peace and safe in the region distinct, making it the center to attract foreign and local investments in various sectors, especially the industrial sector, and although the fact that Jordan relatively poor countries in terms of natural resources, but it is rich in human resources.

  According to the publication that issued by Jordan Chamber of industry (2013) the industrial sector in Jordan divided into the following:

1- **Manufacturing (Converting) sector**; it consists of nine types of industries: Textile and readymade Garments, Therapeutic industries and medical supplies, chemical industries and cosmetic preparations, Plastic and rubber, Engineering, electrical and information technology, Wood and furniture, construction, Food, agricultural and animal stock, and packaging, paper, carton, and office equipments industries. These industries contribute about 14.5% of Jordanian Gross Domestic Product (GDP) in july-2013.

2- **Mining and quarrying**; its includes mining industries. These industries contribute about 1.7% of Jordanian (GDP) in july-2013.

3- **Electricity and water**. These industries contribute about 2.2% of Jordanian (GDP) in july-2013.

The overall contribution of the Industrial sector in Jordan to the Gross Domestic Product for July-2013 was about (23.4%). The value of the total exports for July-2013 was about (2758) JOD million. And the value of the national exports for July-2013 was about (2766) JOD million.

The total number of Industrial establishments reached 15,120 firms, employing about (193,161) workers, the percentage of growth in number of firms about (-0.1%), and (13.0%) the percentage of growth in total employees and the sum of firms capital estimated about (3080) JOD million for July-2013. Whereas 14.3% of the economic establishments operating in the Kingdom, where industrial firms are estimated at 22,471 firm.

2-5 ISO 14001 certificate holders' statistics

The figure (2-2) illustrates the number of certificates granted according to the following regions (Middle East, Central and South Asia, East Asia and Pacific, Europe, North America, Central/ South America, and Africa) during the period (1999 to 2011). Where X-Axis refer to (year), and Y-Axis refer to number of certificates granted. It shows that the numbers of certificates granted in all regions are growing increasingly, also we can noticed that East Asia and Pacific region has the highest order of where the number of certificates granted is estimated at 137335 certificates in 2011. On other hand Africa region has the lower order of where the number of certificates granted is estimated at 1740 certificate in 2011 (ISO. 2011)

In the Middle East region, the number of certificate granted in 2011 is estimated at 2425 certificate, specifically the 48 certificate was granted in Jordan in 2011. (ISO. 2011)

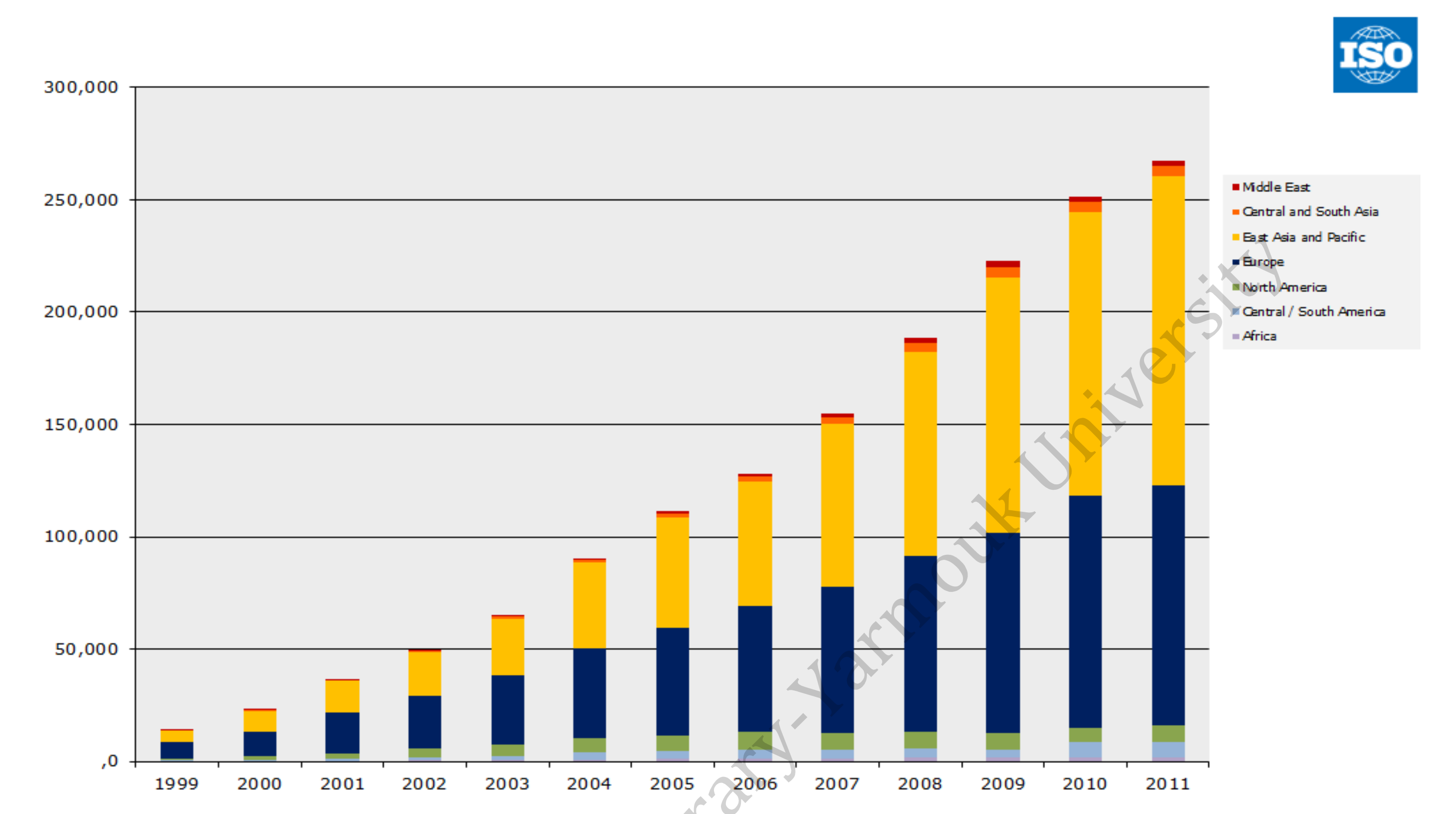


Figure (2-2): Number of certificates granted according to (Year, Regions)

Table (2-3) shows numbers of certificates granted in Jordan over the period (2009-2011). It shows that the numbers of certificates granted in Jordan are growing increasingly and this indicates that many Jordanian firms start to increase their attention to the environmental aspects and maintaining its resources.

Table (2-3): number of certificates granted in Jordan

Year	Jordan
1999	8
2000	16
2001	10
2002	14
2003	39
2004	33
2005	38
2006	39
2007	47
2008	39
2009	64
2010	70
2011	48

Chapter 3: A Conceptual Framework

3-1 Introduction

The aim of this chapter is to define operationally the green manufacturing operational actions and performance indicators, also develop a conceptual model of green manufacturing strategy. This chapter helps in developing the research data collection instrument, also helps in developing the prediction models of green manufacturing strategies in Jordan. This chapter is classified to six sections; the first section discusses the concept of manufacturing strategy content, then, the objectives and key performance indicators are identified, next the scope and actions of green manufacturing strategy are identified, finally a conceptual model of green manufacturing strategy is developed.

3-2 Overview of green Manufacturing strategy content

According to Hong (2009), the Strategic green orientation is an organization's long term commitment for producing environmentally sound products/services through the execution of environmental improvement goals and programs in the past, present and also in the future.

Some of green strategies and techniques that involved in manufacturing paradigm can create products/systems which in turn consumes less materials and energy, substituting input materials, reducing unwanted outputs and converting outputs to inputs (recycling) this reflect the green manufacturing term (Deif. 2011).

According to Li et al. (2010), it can realize the objectives of reducing energy consumption and waste emission, overcome green trade barriers, which are being formed through more and more environmental regulations and laws for Chinese

enterprise by the green manufacturing strategy which is an effective way to achieve these objectives.

Also Lawrence et al. (1998) in their study define the Green manufacturing strategy as the response to the relationship of an organization's products, services and activities with its natural environment, sometimes called an environmental strategy.

In this research green manufacturing strategy content is divided into two main parts; the actions and competitive priorities. The actions are the tactics made by the organizations; however, the competitive priorities are the strategic key performance indicators which are the same as the business level strategy.

3-3 Green manufacturing strategic objectives (key performance indicators)

The objectives are the potential key performance indicators will be realized through the stream of actions, these key performance indicators represent the strategic orientation of particular organization. The firms' performance indicators that are grouped or classified into three categories of firms' performance ; environmental, economical and operational performance based on the previous studies (Zhu et al., 2010; Zhu et al., 2005; and Perotti et al., 2012), then, back to the literature in order to clarify the relationships between the green supply chain management practices and firms' performance.

According to Kaplan and Norton (1996) the traditional financial based performance measurements fails to measure all the critical factors affecting business success/failure, So that firms' financial performance is not the only indicator to measure the performance of the firm . firms' green performance indicators were listed and discussed by different researchers as (Zhu et al., 2010; Zhu et al., 2005; and Perotti et al., 2012),

according to these studies the indicators or dimensions could be classified to environmental performance, economic performance, and operational performance as the following:

a) Environmental performance: these indicators are related to reduction in air emissions, solid wastes, waste water, consumption for hazardous/harmful/toxic materials and frequency for environmental accidents and improve an enterprise's environmental situation...etc.
b) Operational performance: these indicators are related to increase amount of goods delivered on time, decrease inventory levels, scrap rate, promote products' quality, increased product line, improved capacity utilization… etc.
c) Economic (Financial) performance: these indicators are related to decrease of cost for materials purchasing, fee for waste treatment, fee for waste discharge, increase of investment, cost for energy consumption, operational cost, training cost and cost of purchasing environmentally friendly materials…etc.

The following table (3-1): indicates to the most firms' performance indicators that are grouped into three categories based on previous studies.

Table (3-1) Green Operations Key Performance Indicators

Categories of KPI	Key Performance indicator.	Reference
Environmental performance	(1)Reduction of air emissions.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis(2004), Shi et al.(2012), Perotti et al.(2012), Rao(2002),
	(2)Reduction of waste water.	Zhu et al.(2010),Zhu et al. (2005),Zhu and Sarkis(2004), Shi et al.(2012),Perotti et al.(2012)
	(3)Reduction of solid wastes.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis(2004), Shi et al.(2012),Perotti et al.(2012)
	(4)Decrease of consumption for hazardous/harmful/toxic materials.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis(2004),Shi et al.(2012)
	(5)Decrease of frequency for environmental accidents.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis(2004), Perotti et al.(2012)
	(6)Improve an enterprise's environmental situation.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004)
	(7)Improvement of transportation environmental performance (e.g. lower fuel consumption)	Perotti et al.(2012)
	(8)Adopting environmentally friendly purchasing(e.g. purchasing of materials that consist of less environmentally harmful elements)	Shi et al.(2012)
	(9)Increase using of renewable and recyclable resources and using fewer materials	Shi et al.(2012)
Operational performance	(1)Increase amount of goods delivered on time	Zhu et al.(2010),Zhu et al. (2005),Zhu and Sarkis(2004), Perotti et al.(2012)
	(2)Decrease inventory levels	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004), Perotti et al.(2012)
	(3)Decrease scrap rate	Zhu et al.(2010),Zhu et al. (2005),Zhu and Sarkis (2004), Perotti et al.(2012)
	(4)Promote products' quality	Zhu et al.(2010),Zhu et al. (2005),Zhu and Sarkis (2004),Perotti et al.(2012)
	(5)Increased product line.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004)
	(6)Productivity increase	Perotti et al.(2012), Rao (2002),
	(7)Improved capacity utilization.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004),Perotti et al.(2012)
Economic (Financial) performance	(1)Decrease of cost for materials purchasing.	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004), Perotti et al.(2012)
	(2)Decrease of cost for energy consumption	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004), Perotti et al.(2012)
	(3) Decrease of fee for waste treatment	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004), Perotti et al.(2012)
	(4) Decrease of fee for waste discharge	Zhu et al.(2010),Zhu et al.(2005),Zhu and Sarkis (2004)
	(5) Increase of investment	Zhu et al.(2005), Perotti et al.(2012)
	(6) Increase of operational cost	Zhu et al.(2005), Perotti et al.(2012)
	(7) Increase of training cost	Zhu et al.(2005), Perotti et al.(2012)
	(8) Increase cost of purchasing environmentally friendly materials	Zhu et al.(2005), Perotti et al.(2012)
	(9)Market share increase	Perotti et al.(2012)
	(10)Increase of revenues	Perotti et al.(2012)
	(11)Decease of fine for environmental accidents	Perotti et al.(2012),Zhu et al.(2010);

3-4 Scope of green manufacturing strategy

Scope of green manufacturing strategy is the operational processes which are affected by green practices. According to operations management literature, the scope of operations could be extended to include all value chain processes. The value chain processes are classified to supply chain and demand chain. Accordingly, the green manufacturing strategy could be extended to include both supply chain and demand processes.

According to Srivastava (2007) green supply chain practices (GSCP) can refer to a set of variety of initiatives and activities implemented by a firm in an attempt to reduce their impact or effect on the natural environment.

Ninlawan et al. (2010) mentioned the activities of green supply chain management which are:

1. Green procurement: also known as an environmental purchasing consisting of involvement in activities that include the reduction, recycling and reuse of materials in the purchasing process.
2. Green manufacturing: where the inputs used with a relatively low environmental effects that are highly efficient and generate little or low wastes or pollution. Also known as a production processes
3. Green distribution: Green distribution consists of green logistics and green packaging.
    - In which packaging characteristics include size, shape, and materials have an impact on distribution; because of their affect on the transport characteristics of the product.

- Green logistics: this process means retrieving the product from the end customer for the purpose of capturing value or proper disposal. Activities in this process include collection, combined, inspection/selection/sorting, re-processing/direct recovery, redistribution and disposal.

3-5 GSCM practices:

The term green supply chain practices (GSCP) is commonly used in the research literature to refer to a variety of activities performed by an organization in order to minimize or reduce their impact on the natural environment; practices related to environmental performance and issues include both external and internal activities, whether related to preventing pollution before its generated, recycling waste and spent products, extracting resources and raw materials or capturing harmful pollutants followed by proper disposal (Vachon and Klassen, 2006).

According to Zhu and Sarkis (2004) in their study, they focus on four GSCM practices areas; the first area is internal environmental management, the second is external GSCM including green purchasing and cooperating with customers, the third is investment recovery and last is eco-design practices. These four areas or aspects represent some of the main internal and external activities and functions within organizational supply chain management.

Carter and Carter (1998) define GSCP by focusing on the purchasing function, in which suggesting that green supply activities consist of the involvement of the purchasing function in facilitating internally-driven environmental activities such as reuse, recycle and source reduction.

Finally, due to the lack of consensus in the literature about the definition of green supply chain practices, in this research the definition of this term includes all the activities that performed by the organization in an attempt to minimize or reduce their impact on natural environment.

Previous studies concluded that the Green Supply Chain Practices term can be classified into both internally and externally oriented practices, where internal initiatives and activities include implementing environmental management systems and investment recovery, while green purchasing and co-operation with customers green packaging can be classified as external practices (Zhu, *et al*, 2008; Sarkis, et al, 2010).

Whereas studies classified GSCP into external oriented practices only, i.e. environment-related activities involving at least another organization In addition to the focal company. These can be divided into environmental monitoring; supplier requirement for compliance with a voluntary code of practice or public standard, and environmental collaboration; development of co-operative activities to address environmental issues in the supply chain (Vachon and Klassen, 2006).

The GSCPs in this research are classified into groups or categories according to the aspect that the activities serve it. The following tables (3-2, 3-3) show the internally and externally activities divided into groups according to the aspect that the activity serve it, i.e. Internal environmental management practices includes (Commitment of GSCM from senior managers, Support for GSCM from mid-level managers, and so on).

Table (3-2) Green Supply Chain Practices (Internal environment practices)

Green operations practices	References
Commitment of GSCM from senior managers	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010), Zhu et al. (2010), Xie and Breen (2012), Rha (2010),
Support for GSCM from mid-level managers	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Cross-functional cooperation for environmental improvements	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010) , Zhu et al. (2010), Xie and Breen (2012), Rha (2010),
Total quality environmental management	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Green operations practices	**References**
Environmental compliance and auditing programs	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
ISO 14001 certification	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Environmental management system exist	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Environmental performance measurement and monitoring	Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010)
Use of "green IT" (e.g. reduction of server number, use of green software, optimization of backup number)	Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010)
Promote industry cooperative effort	Perotti et al.(2012), Murphy and Poist (2000), Zhu and Sarkis (2004), Carter and Rogers (2008), Zhu et al. (2008), Jumadi and Zailani (2010) and Lieb and Lieb (2010)

Table (3-3) Green Supply Chain Practices (External environment practices)

Green operations practices	Reference
Cooperation with suppliers :Green Purchasing	
Providing design specification to suppliers that include environmental requirements for purchased items	Zhu et al.(2005), Perotti et al.(2012),Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006),Vachon and Klassen(2006), Vachon(2007) and Zhu et al. (2008) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010), Rao (2002)
Cooperation with suppliers for environmental objectives	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006),Vachon and Klassen(2006), Vachon(2007) and Zhu et al. (2008) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Environmental audit for suppliers' internal management	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006),Vachon and Klassen(2006), Vachon(2007) and Zhu et al. (2008) , Zhu et al. (2010), Rha (2010),
Suppliers' ISO14000 certification	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006),Vachon and Klassen(2006), Vachon(2007) and Zhu et al. (2008) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Second-tier supplier environmentally friendly practice evaluation	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006),Vachon and Klassen(2006), Vachon(2007) and Zhu et al. (2008) , Zhu et al. (2010), Rha (2010),
Cooperation with customers: Customer Cooperation with environmental consideration	
Cooperation with customer for eco-design	Zhu et al.(2005), Perotti et al.(2012),Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Zhu and Sarkis(2004), Zhu et al. (2008), Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010), Rao (2002),
Cooperation with customers for cleaner production	Zhu et al.(2005), Perotti et al.(2012),Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Zhu and Sarkis(2004), Zhu et al. (2008), Lieb and Lieb (2010) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Cooperation with customers for green packaging	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Zhu and Sarkis(2004), Zhu et al. (2008), Lieb and Lieb (2010) , Zhu et al. (2010), Xie and Breen (2012), Rha (2010),
Membership in an Eco-Industrial Park	Perotti et al.(2012),Zhu and Sarkis(2004), Zhu et al. (2008), Lieb and Lieb (2010)
Eco-design and packaging	
Design of products for reduced consumption of material/energy	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000) , Zhu et al. (2010), Xie and Breen (2012), Zhu and Sarkis (2004), Rha (2010),
Design of products for reuse, recycle, recovery of	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and

materials, component part	Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006), Tsoulfas and Pappis (2008), Zhu et al. (2008) and Jumadi and Zailani (2010) , Zhu et al. (2010), Xie and Breen (2012), Rha (2010),
Design of products to avoid or reduce use of hazardous of products and/or their manufacturing process	Zhu et al.(2005), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000) , Zhu et al. (2010) , Xie and Breen (2012),Zhu and Sarkis (2004), Rha (2010),
use of biodegradable materials	Perotti et al.(2012),Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006), Tsoulfas and Pappis (2008), Zhu et al. (2008) and Jumadi and Zailani (2010) , Xie and Breen (2012),
Packaging design for reduced environmental impact	Perotti et al.(2012),Faruk et al.(2002), Zhu and Sarkis(2004), Gonzalez-Benito and Gonzalez-Benito(2006), Tsoulfas and Pappis (2008), Zhu et al. (2008) and Jumadi and Zailani (2010) , Xie and Breen (2012),
Investment recovery	
Investment recovery(sale) of excess inventories/materials	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000),Zhu and Sarkis(2004), Zhu et al. (2008) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Sale of scrap and used materials	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Zhu and Sarkis(2004), Zhu et al. (2008) , Zhu et al. (2010) , Xie and Breen (2012), Rha (2010),
Sale of excess capital equipment	Zhu et al.(2005), Perotti et al.(2012), Zsidisin and Hendrick(1998),Walton et al.(1998), Carter et al.(2000), Zhu and Sarkis(2004), Zhu et al. (2008) , Zhu et al. (2010), Rha (2010),
Distribution strategies and transportation execution	
(Re) design of logistics system components for higher environmental efficiency	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011) , Xie and Breen (2012), Rao (2002),
Environmentally friendly facility location	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011) , Xie and Breen (2012),
Use of alternative fuels	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011)
Mode selection based on "eco-friendly" parameters	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011) , Xie and Breen (2012),
Use of more recent/less polluting vehicles	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011)
Effective shipment consolidation and full vehicle loading	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011)
Routing systems to minimize travel distances	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011)

Vehicle maintenance and disposal	Perotti et al.(2012),Faruk et al.(2002), Gonzalez-Benito and Gonzalez-Benito(2006), Lin and Ho(2008), Jumadi and Zailani (2010), Lieb and Lieb (2010) and Langella and Zanoni(2011)
Warehousing and green building	
Attention to construction materials (e.g. use of recycled concrete, steel, asphalt and other materials)	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010)
Building thermal insulation	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010)
Day lighting (installing skylights and clerestory windows in distribution facilities allows companies to use natural light as a source of interior illumination)	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010)
Energy- efficient lighting systems	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010)
Energy- efficient material handling equipment	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010)
Use of alternative energy sources (e.g. solar or photovoltaic panels)	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010), Rao(2002),
Water systems (e.g. plants and landscaping materials that minimize water waste , use of "gray water" systems)	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Rizzo(2006), Lin and Ho(2008), Lieb and Lieb (2010), Jumadi and Zailani (2010)
Reverse logistics	
Waste transport and disposal	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Tsoulfas and Pappis (2008) , Xie and Breen (2012),
Materials recycle whenever possible	Perotti et al.(2012),Murphy and Poist (2000), Hervani et al.(2005), Tsoulfas and Pappis (2008)
Consumption reduction whenever possible	Perotti et al.(2012),Murphy and Poist (2000), Hervani et al.(2005), Tsoulfas and Pappis (2008)
Materials reuse whenever possible	Perotti et al.(2012),Murphy and Poist (2000),Hervani et al.(2005), Tsoulfas and Pappis (2008)

3-6 The conceptual framework of green manufacturing strategy

3-6-1 The relationship between green manufacturing objectives and green operations actions

According to Hong et al. (2009); the supply chain coordination and integrated product development is affected by the green strategic orientation.

Chien and Shih (2007) studied the relationship between green supply chain management practices and environmental performance, as well as financial performance. The results

of this study indicating that the implementation of green supply chain management practices has a positive relationship with the environmental performance of corporations. On other hand, from the financial perspective, we can provide benefits to organizations, including cost reduction, profit increase and market share growth through the implementation of green supply chain management practices.

From an economic performance perspective of organization, Alvarez et al. (2001) indicated that environmental management such as green supply chain management has a positive relationship with an organization's economic performance.

Lippman (2001) indicates that based on his interviews with small supplying firms, through adopting green supply chain practices organizations experience increases in their operational outcomes, such as reduction in cycle time and cost, and in a few cases increases in sales. In addition, King et al. (2005) in their study stating that environmental practices such as ISO 14001 results in relatively enhanced environmental performance.

As well as, Lee (2009) in his study "Why and how to adopt green management into business organizations?" conducted case studies on green management of SMEs, the findings of his study present that systematic green management helps reduce production costs by enhancing operational efficiencies such as less water consumption, reduced waste water generation and saved materials usage.

Its generally perceived that green supply chain practices (GSCP) help to enhance and improve environmental performance; where minimize waste, achieve cost savings, then promotes efficiency and synergy among business partners and their lead corporations (Lin. 2007).

3-6-2 The relationship between green operations actions

This section Review the relationship between green operations actions; internal and external practices.

According to Shi et al. (2012); the intra-organizational practices affect the inter-organizational practices. In addition, Green Jr et al. (2012) in their study indicate that the internal environment management affects the green purchasing, cooperation with customers, eco-design.

3-6-3 The relationship between green operations actions and performance indicators

A review of the existing literature has highlighted a need to understand how green supply chain practices can contribute to improving firm performance from three different performance dimensions; environmental, economic, as well as, operational. In this research will investigate the green supply chain actions adopted by manufacturing firms in Jordan, especially those firms that realized the ISO 14001, in terms of specific green supply chain actions implemented and the level of adoption of each action, explore how this adoption can affect the company performance, in terms of the firms' performance dimensions mentioned above.

Previous studies have explored the relationship between Green Supply Chain Management practices and firm's performance indicators or dimensions including environmental, economic and operational performance. For instance Shi et al. (2012) in their study indicated that a measurement of green supply chain management performance is relatively new in this multi-disciplinary research area, and promises to give an opportunity for enterprises to assess their performance after implementing a

GSCM strategy. The evaluation of Green Supply Chain Management performance cannot just be based on its financial area or aspect. Other aspects in the business like intangibles ones including environmental aspects need to be integrated at a strategic level (Kaplan and Norton, 2001). Moreover, should consider the operational aspect as an important indicator especially in the manufacturing firms when evaluating the firm's' performance.

Shi et al. (2012) in their study proposed to use the three performance indicators; environmental, operational as well as financial measures to explore the impacts from green supply chain management practices.

Potential patterns of supply chain relations for improving environmental performance offered by the literature (Florida, 1996; Florida and Davison, 2001; Geffen and Rothenberg, 2000; Green et al., 1996; Handfield et al., 2002; Sarkis, 1995). Zhu, (2005) in his study support such positive relationships is relatively strong. Also, Frosch (1994) argued that inter-firm linkage facilitated by proximity could lead to enhancement or improvement in environmental performance. As well as, Geffen and Rothenberg (2000) in their study it can aid the adoption and development of innovative environmental technologies through the relations with suppliers.

Wagner et al. (2001) in their study indicated that the relationship between green supply chain management practices and economic performance is still mixed. On other hand, Alvarez et al. (2001) in their study concluded that environmental management like green supply chain management has a positive relationship with an organization's economic performance.

As for the operational performance; using a case study of the first Japanese integrated mill of pulp and paper that gained the certification of ISO 14001, Tooru (2001) has

proved that environmental management systems like ISO 14001 can improve operational performance of a firm. Also, Hanna et al. (2000) in their study demonstrate that there is a strong relationship between operational goals and outcomes of the teams and the positive environmental impact outcome. As well as Szwilski (2000) put forward that an environmental management system is an information management tool and innovative environmental policy for industry to enhance organizational operational performance.

Finally, the reasons for variation in the literature findings may be due to the heterogeneity of the types of environmental management actions or practices adopted by the firms and industries.

Now, it will be useful to summarize the relationships between both firms' internal, external practices and performance indicators to be able to build the conceptual framework of green manufacturing strategy; according to Lee et al. (2012) the most anticipated findings of their study was a direct link between green supply chain management practice implementation and business performance, also green supply chain management practice significantly affect the operational, rational efficiency and business performance. Also, Shi et al. (2012) indicate that the inter-organizational and intra-organizational practices affect the operational and environmental performance, and inter-organizational practices affects the financial performance. Perotti et al. (2012) in their study demonstrate that the economic and environmental performances are the most affected indicators by the green supply chain practices. According to Green at al. (2012) green purchasing, cooperation with customers and eco-design affects the environmental performance and economic performance.

Socially responsible firms Released on the companies that adopt the environmental management or green supply chain management (Borger and Kruglianskas, 2006; Montiel, 2008; Cruz and Pedrozo, 2009).

Many studies have asserted that there is a positive relationship between corporate social responsibility (CSR) and the firm's business performance. For instance, according to McGuire et al. (1988), indicate that firm's business performance and corporate social responsibility is positively related, such as stock market returns and accounting- based measures.

3-6-4 The relationship between performance indicators

According to Shi et al. (2012); the environmental performance affects the operational performance, and the operational and environmental performance affects the financial performance. According to Lee et al. (2012) the operational and rational efficiency affects the business performance; according to Green Jr et al. (2012) the environmental performance and economic performance affect the organizational and operational performance. According to Hong et al. (2009); the green performance outcomes affects the business unit performance.

Moneva and ortas (2010) in their study "corporate environmental and financial performance: a multivariate approach" discovered that environmental performance has a positive correlation with financial performance of the firm. In their event study, the authors analyzed corporate environmental performance (CEP) in 2004 and corporate financial performance (CFP) in the 2005-2007 periods. Then, they tested the three relationships between CEP in 2004 and CFP in 2005; CEP in 2004 and CFP 2006; CEP in 2004 and CFP 2007. The results of the tests in this research present that corporate

environmental performance enhances firms' internal efficiency and their corporate financial performance in the future periods.

3-6-5 The Conceptual framework:

Figure (3-1) shows the conceptual framework of green manufacturing strategy developed by the researcher using previous studies that explained in the previous sections ; it can be seen that the relationships have reported by previous studies are still abstractive, the detailed relationship between the details of each dimension is still not reported.

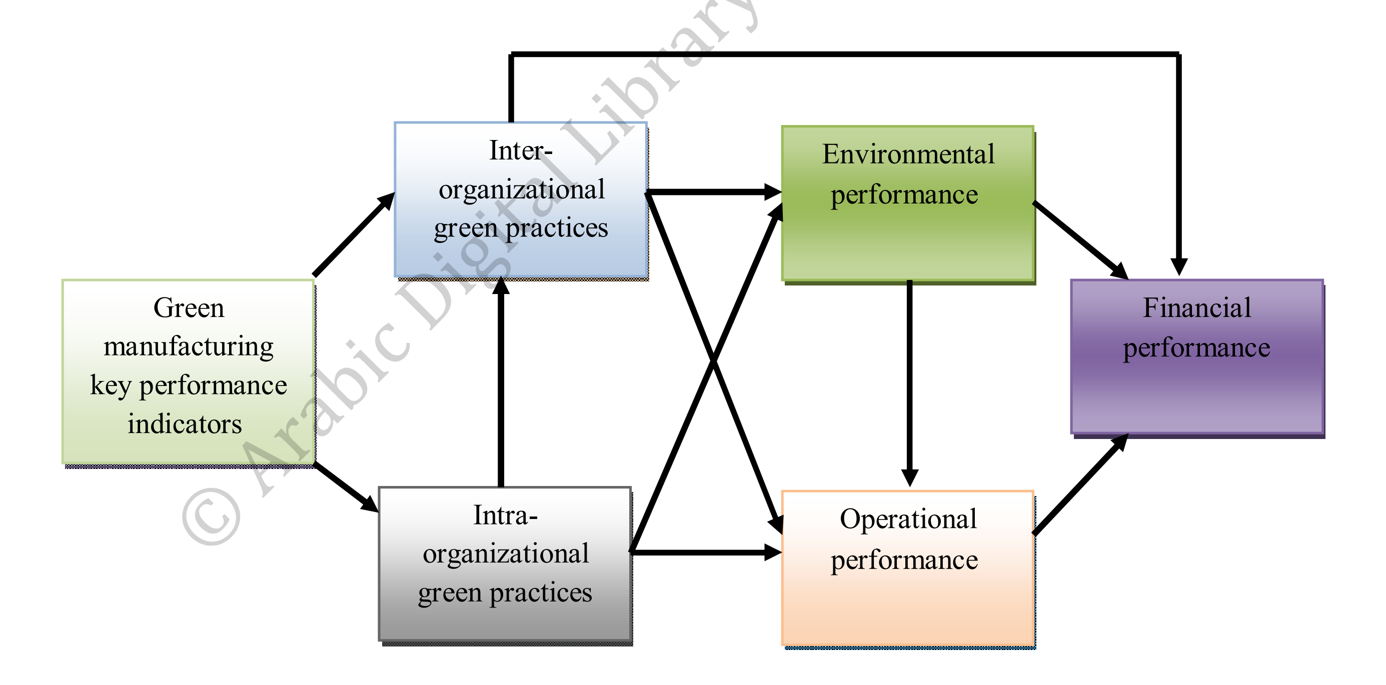


Figure (3-1) The conceptual framework of green manufacturing strategy

3-7 Conclusions

The key performance indicators of green manufacturing strategy could be classified to; environmental, economic and financial, the realization of these indicators is affected by green manufacturing practices, these practices are classified according to value chain view point to; green purchasing, green product design, green manufacturing, green distribution and green reverse logistics. There is a lot of relationship between strategic orientation, practices and performance indicators; these relationship are presented in a conceptual model.

Chapter 4: Literature review of ISO 14001 studies

4-1 Introduction:

The main purpose of this chapter is to review the previous studies, and to know the aspects or areas that focused on it. And illustrate the major contribution of this research.

4-2 Literature review about ISO 14001:

The study from Japan conducted by Arimura et al. (2011) determined the influence of ISO 14001 certification on the green supply chain management (GSCM) by using Japanese facility level-data. The study proved that ISO 14001 and also voluntary environmental management system (EMS) government program are significantly influence GSCM practices. These programs highly perhaps the facilities will evaluate their suppliers' environmental performance and ask suppliers to undertake specific environmental practice.

Toshi et al. (2010) estimated that we can promote more advanced practices, and this practices called Green Supply Chain Management (GSCM) through the effects of ISO 14001 certification. The results showed that the facilities with environmental management systems (EMS) certified to ISO 14001 are 50% more likely to require that their suppliers undertake specific environmental practices, as well as 40% more likely to assess their suppliers' environmental performance. Further, indirectly way, the approaches of government encourage voluntary environmental management system (EMS), So that the government programs increase the probabilities that the supplier's environmental performance will be assessed by the facilities and require the suppliers to Pledge some or specific environmental practices by 7% and 8% respectively.

Nawrocka et al. (2009) in their study about the role of ISO 14001 in environmental supply chain management practices in Swedish companies; the study described the existing and potential role of ISO 14001 for three key operational tasks of environmental supply chain management: to communicate the requirements to the suppliers, to motivate and enable the suppliers and to verify that the suppliers follows the requirements.

Nga (2009) studied the influence of ISO14000 on firm performance; the study seek to bridge the lacuna in research on the influence of ISO14000 certification on firm financial performance in Malaysia, by using a sample of main board companies in the customer product, industrial product-construction and property sectors. The study screens ISO adopters with non-adopters based on certain pertinent criteria such as nature of the firm, product and/or services, reputation, export operation ad weather they are ISO 9000 certified. The results found that ISO 14000 certification improves average return of equity but not necessarily in terms of sales and capitalization, the study implies that ISO 14000 may bring certain benefits in terms of cost reductions through production efficiencies.

A study about ISO14001 and sustainable development, the purpose of his study is to discuss the relation between the sustainable development and the ISO14001 standard. Also, the researcher provides an example of the influence of the environmental management system (EMS) according to ISO 14001 on sustainable development and environmental quality, so he presents a case study within the Poland in the energy sector. He discussed the relation between the sustainable development and the ISO14001 standard by comparing the ICC business Charter for sustainable Development with ISO14001 series. He introduced the company under research; this case study is based on analysis of the fulfillment of environmental goals and tasks,

which are part of the environmental management system (EMS). The findings of this research indicated that the case study provides arguments that the sustainable development may support by ISO14001 standard, especially when there is a problem of enforcement of legal requirements, in other words when the enforcement of environmental laws and regulation is inefficient (Fortunski. 2008)

Rao (2002) conduct a study aimed to determine to what extent this greening of the supply chain is taking place in South East Asia encompassing the Indonesia, Philippines, Thailand and Singapore, Malaysia , the author used a survey questionnaire as a research instrument. The research intended to cover an exploratory analysis to investigate the environmental initiatives pledge by leading edge companies in order to enhance their own environmental performance and the features of greening of suppliers being established by them for their suppliers. The main manufacturing activity, number of employees, if they had ISO 9000 certification, ISO 14001certification , …, etc. all these element are inquired in the questionnaire. This study came out the following results; there was a significant link between environmental initiative (e.g. taking environment criteria into consideration, environmental friendly raw material,…etc) and environmental performance of the company(e.g. reduction of emission, reduction of solid/liquid waste,…etc), these initiatives led the firms to go beyond and help their suppliers/contractors turn green, supply chain environmental management did lead to environmental performance of the firm, which in turn led to competitiveness and economic performance.

A recent study conducted using questionnaire-survey approach, in order to identify the critical factors (CFs) of ISO 14000; to find out if can improve organizational performance by ISO 14000 certification, and to analyze the levels of and changes in these CFs and levels of and changes in the indicators of organizational performance

(IOPs) in relation to firm attributes considered in this study. Also, to obtain the practitioners perceptions of ISO14000 certification, levels of presence of critical factors and changes in critical factors due to certification, levels of presence of indicators of organizational performance and changes in indicators of organizational performance due to certification. Statistical techniques used in order to analyze the data collected. The firms regard the preparation for emergencies as an integral part of environmental management system (EMS), and they seem to initially struggle to identify environmental issues that are to be given higher importance. Further, they results that its difficult continuously improve their environmental management processes in a continually manner. There are significant changes in all the critical factors and indicators of organizational performance due to ISO 14000 certification. Furthermore, less-experienced firms have lower mean values of levels of all critical factors, in comparisons with more experienced firms. Finally, in order to realize long-term benefits these firms appear to understand the EMS and effectively implement it (Padma, *et al*, 2008).

Another study that analyze the difficulties and problems that may be encountered in the implementation of ISO14000 in construction. Then the researchers proposed the framework for implementing the ISO14000.it is suggested that the construction companies may improve their environmental performance which in turn will contribute to a sustainable development by adopting ISO14000. In short, we can links the construction procurement process with the sustainable development through a mechanism provided by ISO14000 (Zhang, *et al*, 2000).

In order to evaluate the success factors to execute or implement ISO 14001- Based Environmental Management System, the researchers formulate an appropriate model for

the above purpose. This model performs the cost/benefit analysis using the analytical hierarchy process methodology. The findings of their research conclude that the implementation of Environmental Management System by manufacturing companies would improve their environmental performance and sustain their competitive position, regardless of the costs that incurred from its execution (Chin, *et al*, 1999) .Ball (2002) observed that adoption of ISO 14000 seemed to be a much better way of steering the construction industry towards improved environmental performance.

Accordingly, Turk (2009) mentioned on his study about ISO 14000 environmental management systems which conducted the Turkish construction industry. Turk study used the questionnaire survey methodology. The survey was conducted with 68 individual construction firms which represent the top category in turkey and operate in national and international markets. The obtained data for Turk's survey was analyzed in accordance with the objective study, and the following points summarize the conclusion of the study:

- The number of ISO 14001 certificates held by construction firms in Turkey is observed to be low when compared to other countries, particularly European and Asian countries.
- The study shows that there is appositive approach to the ISO 14000 Environmental Management System within the construction sector in turkey as well as indicating that the utilization of the ISO 14000 is not yet at the preferred level.

Cassells et al. (2012), conduct another study, which aimed to report success factor for the implementation of ISO 14001, as well as benefits of, the barriers to, adoption. The

study was based on data from a survey of all ISO 14001 certified firms in New Zealand. The following points summarize the result of the study:

- Capability building, and planning and strategy, with process management of lesser importance are the key factors reported as being critical to the successful implementation of an ISO 14001driven EMS for the respondent firms.
- Primarily implantation processes and costs, with external engagement, information and infrastructure, and contractor commitment deemed lesser barriers are the factors recognized as potential barriers to successful ISO 14001 adoptions.
- Environmental outcomes and perceptions, compliance related performance, environmental operating performance, and, lastly, competitive orientation are the Perceived benefits of ISO 14001 adoption.

Another study done by Hariz and Bahmed (2013), where they conduct an assessment of environmental management system performance in the Algerian companies certified ISO 14001, the study aimed to provide an immediate image about the reality of the environmental management system (EMS), as experienced by Algerian companies certified to ISO 14001. The adopted approach in their study focused on the evaluation of different elements concerning the requirement of the ISO 14001 standard, by the audit which shapes the appropriate tool for the evaluation of such a system of management. The analysis of the obtained results showing that the success of the different elements concerning the requirements of ISO 14001, which reflect the same conditions that are needed for the success of the improvement of the Environmental Management System. Also, the results allows putting forward the orientation that should be implemented by any Algerian companies, such as for a real keep progress in

improvement of their environmental performances, within the framework of a lasting protection of the environment, this an example of the selected ones in this study.

4-3 conclusion:

After revising the previous studies about ISO14001 it can be criticized:

- The majority of previous studies focused on the motivation, the barriers and the successful implementation of ISO 14001.
- The effective manufacturing patterns adopted by ISO14001 holders are a limited research issue.
- The previous studies did not make clusters of organizations and developed strategy patterns of green manufacturing strategies.
- The majority of previous studies surveyed organizations in developed or in transitions countries.
- Accordingly, this study will identify the different green manufacturing strategies patterns adopted by ISO 14001 in Jordan.

Chapter 5: Research methodology

5-1 introduction

This chapter aims to identify the research methodologies, analytical and data collecting instruments, and the techniques that are used in order to achieve the research aims and objectives, and to illustrate the phases of this research. The chapter shows how to achieve each objective alone, and finally, it integrates these objectives which are realized using different methodologies in order to answer the research question.

5-2 Thesis aim, objectives and question

Aim:

The research aims to identify different green strategies of the Jordanian manufacturing firms' that adopted ISO 14001 standards.

Objectives:

1. Using the literature to operationally define the Key Performance Indicators, Green Actions, and Performance Indicators.
2. Identifying the Key performance indicators that the manufacturing firm seeks to realize.
3. Identifying the green operations actions made by the manufacturing organizations realized ISO 14001 standards in Jordan.
4. Identifying the Performance indicators realized by the manufacturing organizations realized ISO 14001 standards in Jordan.
5. Clustering the manufacturing organization according to Key Performance Indicators in Jordan.

6. Identifying the significant actions made by the different clusters of manufacturing organization realized ISO 14001 standards in Jordan.
7. Identifying the significant performance indicators realized by each manufacturing firm cluster.

Research Question

What are the taxonomies of green manufacturing strategies adopted by the ISO 14001 holders in Jordan?

After achieving the previous research objectives, this will led to answer of the research question. Both data collections and data analysis are discussed in this chapter and chapter (6).

5-3Research methodology phases:

Figure (5-1) shows the process flow of the research, it illustrates that research passed through five phases, and each phase will be discussed in depth in this chapter and chapter (6).

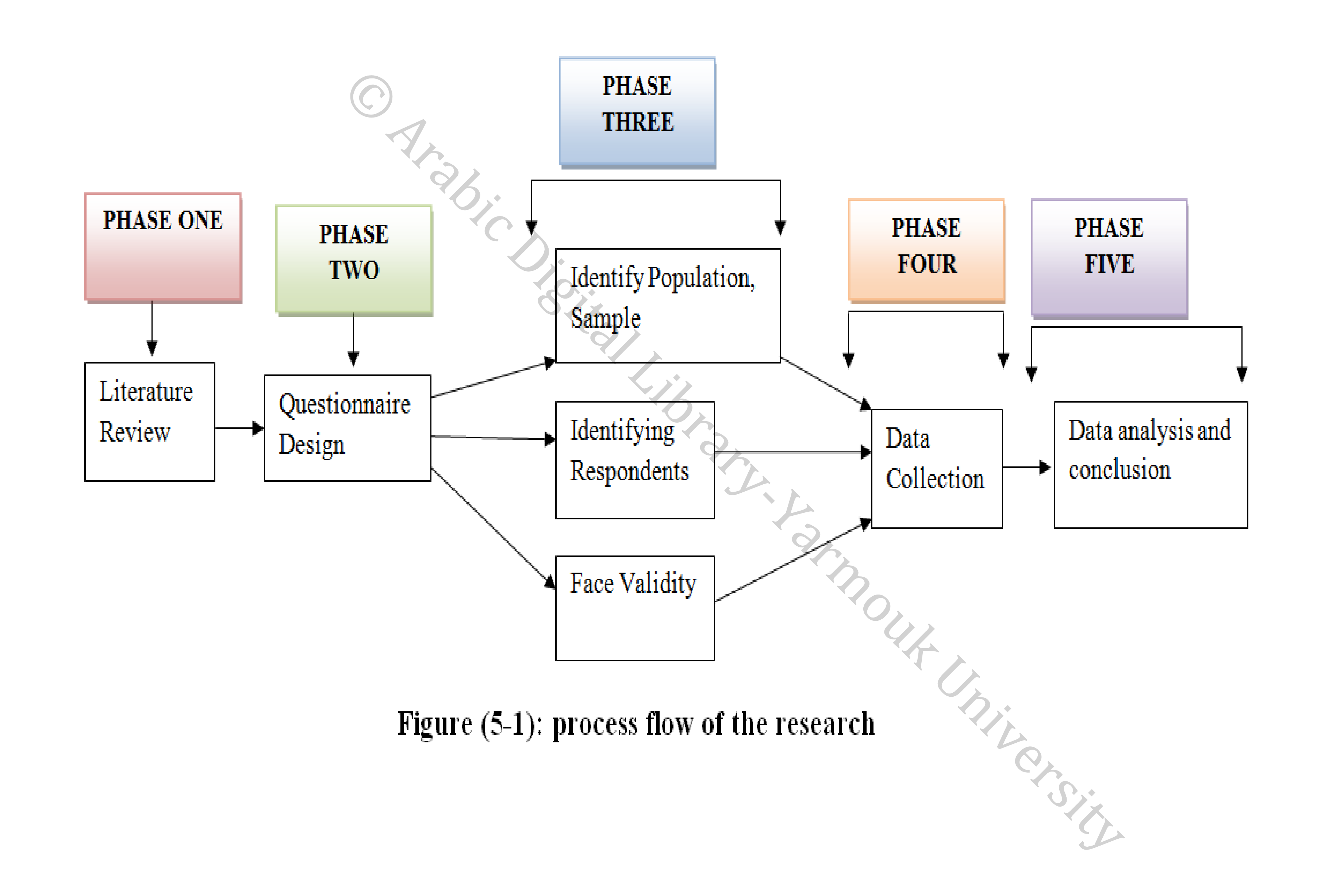


Figure (5-1): process flow of the research

5-3-1The First Phase: Literature Review

The researcher follows the following steps in the first phase:

1. The previous studies of green supply chain management (e.g. Zhu and Sarkis (2004),Xie and Breen (2012),Zhu, Sarkis, and Geng (2005),…etc.) and green operations strategies (e.g. Lawrence et al. (1998), Hong (2009),…etc) were revised to identify the elements of green manufacturing strategy. This revision is clearly reported in chapter (3).
2. The main elements of manufacturing strategy according to this revision are:
   a. **Key Performance Indicators**: Key Performance indicators are divided into three dimensions of performance in order to cover the majority aspects of performance, these aspects or dimension are: environmental, the second is operational, and the last is economic or financial.
   b. **Green Operation Actions:** covering eight dimensions; internal environmental management, Cooperation with suppliers (or Green Purchasing), Cooperation with customers (or Customer Cooperation with environmental consideration), Eco-design and packaging, Investment recovery, Distribution strategies and transportation execution, Distribution strategies and transportation execution, Reverse logistics.
   c. **Performance Indicators**: also, performance indicators are divided into three dimensions of performance in order to cover the majority aspects of performance, these aspects or dimension are: environmental, the second is operational, and the last is economic or financial.
3. The relationships between the elements, or what is called the conceptual model of green manufacturing strategy were identified (See chapter (3)).

4. The details items of each dimension of green operations strategy were identified (Also See chapter (3))

5-3-2 The second Phase: Questionnaire Design

1. The dimensions and items of questionnaire were identified clearly by revising the literature. The following table (5-1) shows the number of dimensions and elements in each section in the research questionnaire; section one contains three dimensions and 26 elements or questions about these three dimensions, section two contains eight dimensions and 51 elements or questions related to these dimensions,… and so on.

Table (5-1): Questionnaire dimensions and elements

Section	# of dimension	# of element
1:Key-performance indicators	3	26
2: green operation actions	8	51
3: performance indicators	3	26

The scales of the research questionnaire were identified as follows:

a- The scales of the second section of the questionnaire (that asks about Key performance indicators that the manufacturing firm seeks to realize) were:

0= not at all

1= taken very low degree

2= taken a low degree

3= taken a medium degree

4= taken significantly

5= taken very significantly

b- The scales of the third section of the questionnaire (that asks about the level of applying the green practices in the manufacturing firms that adopt ISO14001) were:

0= Not considering at all

1= extremely low

2= low

3= moderate

4= High

5= Extremely high

c- The scale of the fourth section of the research (that asks about level of performance in the firms that resulted by adopting ISO 14001) were:

0= Not at all: 0%

1= Very low: 1-21%

2= low: 21-40%

3= moderate: 41-60%

4= significantly: 61-80%

5= Very significantly: 81-100%

d- The ranges of scales for cluster, significant action, significant key performance indicators centroids.

From 0 >= between <= 2.4: Low

From 2.5 >= between <=3.4: Moderate

From 3.5 >= between <=5: High

5-3-3-1 The third Phase: face validity

1- The experts from the industry and academics were asked about the validity of the research questionnaire, to be sure all elements of the questionnaire are measured in accurate way using the questionnaire instrument. The industry experts asked were consultants of ISO14001 accreditation at consultation corporations. The number of experts was 3, and the number of academics was 5. The duration of time it took in face validity phase was 3 weeks.

2- After completed face validity process by the experts and academics, they gave the researcher specific recommendation about the questionnaire based on their experience, these recommendation are shown in table (5-2). Then researcher make corrective actions based on the previous recommendation from experts and academics as shown in table (5-2).

Table (5-2): the recommendations and corrective actions in phase validity phase.

#	**The recommendations of experts and academics were:**	**Corrective action**
1.	The questionnaire was too long.	All dimensions and elements in the questionnaire were significant to cover the objectives and aims of this research, but in order to overcome this problem, the researcher gave the respondents enough time to fill all the questionnaire, the period was about one month.
2.	Some of the questionnaire element asks more than one question.	The researcher Segmented the elements that ask more than one questions into several questions so that each question asks for only one thing.
3.	Some of the elements related to specific dimension were not enough to cover this dimension.	The researcher added more elements in the dimensions, so that the elements in each dimension enough to cover the related dimension.
4.	Wording of some questions was unclear.	The researcher re-worded the questions, so that the questions became clear.
5.	Some of elements or questions were duplicated (two questions led to the same objective).	Duplicated question deleted by the researcher. So that each question was unique and led to one objective.

5-3-3-2 Identify the source of population, sample and source of data

The population of this research includes all the manufacturing firms that adopt ISO14001 in Jordan. There is no statistics about number of manufacturing firms that adopt ISO14001 in Jordan (According to aware of researcher).

So that the researcher follow the following steps to determine the research population and sample

1- The researcher contact with all consulting firms that grant ISO 14001 in Jordan, in order to determine the population and sample of this research?. In which there are five firms that grant ISO 14001 officially in Jordan; SGS, Lloyds, DNV, TUV, and Absolute Quality Certification (AQC).

2- The researcher hoped to include the total population and try a lot, but some of the granted firms in Jordan have reservation to disclose their clients' information. Two of the consultation firms mentioned above (step1) gave the researcher only the number of the manufacturing firms' clients that adopt ISO14001.

3- So that, in this research the researcher used convince sampling technique: it is a non-probability sampling technique; because the population of this research is unknown precisely, in which the researcher used any manufacturing firms that adopt ISO14001 in Jordan that are available to participate in the research study. Thus, the researcher took a list of manufacturing firms that adopt ISO14001 in Jordan from the other three consulting of ISO 14001 accreditation firms mentioned above (step1) that cooperated and helped the researcher to complete the research objectives.

4- Also, Snowball sampling technique used in this research to reach the greatest numbers of manufacturing firms that adopt ISO14001. Snowball sampling

technique is also one of a non-probability sampling technique that is used when members of population are difficult to locate. Based on this technique the researcher contacted each manufacturing firms that adopt ISO14001 that got from the consultation firms (step2), and the researcher asked about other manufacturing firms that adopt ISO 14001 that may know.

5- After that, the researcher had an approximately number of about the total population through the techniques mentioned in step 2 and 3.

   a- Where the approximated number of population about (40) manufacturing firms that adopt ISO 14001.

   b- Maximum sample size that the researcher reached was (27) manufacturing firms that adopt ISO 14001.

   c- Sample size form about 67.5 from the total population.

5-3-3-3: Identifying the respondents

After the researcher contacted with the concerned persons in each manufacturing firms that adopt ISO14001 (respondents), the main characteristics of the research respondents became a clear and shown in the following table (5-3), according to their age, gender, job title.

Table (5-3): The main characteristics of research respondents				
character	**Age**	**Gender**	**Job title**	**Year that the firm get certified**
Value or percent	-78% from the respondents aged (30 year) and over. -22% from the respondents aged lower (30 year).	-78% from the respondents were male. -22% from the respondents were female.	62.9% of the respondents were ranging from quality manager, quality assurance, Engineer of quality, public safety and environment of projects. And the other is manager of project, general manager ...etc.	62.9% of the respondents' firm gets the ISO 14001 certification in 2005 and above it.

5-3-4 Fourth phase: Data collection

After accomplishing the previous phases; developing the conceptual model, where the main variables measurements are clearly identified, and the population, sample and respondents characteristics are determined, then the fourth phase is began: Data Collection by determining the ways that the questionnaire will distribute.

- The data gathered by the researcher herself via interviews; in which the researcher interviewed some of the ISO 14001 practitioners, so the researcher got to know what are the requirements and conditions to be implemented in order to obtain the certification of ISO 14001, and to shape a full idea about this ISO. Also, the questionnaire sent via E-mail and fax where other respondents answered.
- The respondents were interested to fill the questionnaire, some of them contacted with the researcher via mobile or email to ask about some questions in the questionnaire. Note: The duration of data collection phase was about one month.
- After this period, the respondents return the filled questionnaire by the ways mentioned above.

5-3-5 Fifth phase: Data Analysis

The research used different analysis techniques to achieve research objectives and aims, so this phase will illustrates the techniques used in this research in briefly way.

1. K-mean clustering analysis: is a statistical technique that used to group respondents together. So, it's a grouping technique. The main purpose of this analysis is to categorize n objects in k (in which k greater than one) groups, called clusters, by using p (in which b greater than one) variables, in SPSS we can determine the criteria for updating the cluster centers by using iteration option, and the default value for it is 10.

   This analysis way used in this research to realize the fifth objective of this research: Clustering the manufacturing organizations that adopt ISO14001 according to Key performance indicators in Jordan. All clustering trials were generated, and the significant clusters were identified.

2. Ranking method: to rank the elements accordance to each cluster.

   This analysis was used to realize the sixth and seventh objectives: Identifying the significant actions made and performance indicators realized by the different clusters of manufacturing organization realized ISO 14001 standards in Jordan.

5-4 Conclusion

This chapter intended to develop the empirical research phase in order to achieve the research aims and objectives, and show how to answer to the research question through five phases discussed in figure (5-1).

The justifications for sample was discussed, the sample includes 27 manufacturing firms that adopts ISO14001, in which the researcher used a convenience and snowball sampling techniques in order to reach the largest number of respondents. Also, data colleting instruments and data analysis techniques are discussed.

Chapter 6: Data analysis and findings

6-1 Introduction

The purpose of this chapter is to analyze the data to answer the research question which was derived from research aim and objectives.

Accordingly, in this chapter the fifth and sixth objectives were realized, so the manufacturing organization were clustered according to Key performance indicators in Jordan, the significant actions made by the different clusters of manufacturing organization adopt ISO14001 standards in Jordan were identified, and the significant performance indicators realized by each cluster were identified too.

6-2 Clusters of organizations according to key performance indicators

After collecting the data from the respondents, key performance indicators grouped into three dimensions; environmental, operational, and Economic or financial indicators. Then average of Key performance indicators groups by each organization will be computed. Then the organizations clustered by using SPSS K-means cluster analysis technique, several trial and errors done to estimate the optimal clusters with 10 iterations. Optimal numbers of clusters way identified with three clusters. Table (6-2) shows the result of this analysis.

The explanations in which why three clusters is the optimal number of green manufacturing strategies is to: Statistically, the maximum rate of changes in sum mean square error determines the optimal number of cluster needed where the noise is

minimal. And the following table (6-1) shows the summation of mean square error for each number of clusters, and figure (6-1) shows that graphically.

Table (6-1): summation of mean square error for each number of clusters.

Key performance indicators	Mean square error of three clusters	Mean square error of four clusters	Mean square error of five clusters
Environmental key performance indicators	.138	.093	.092
Environmental key performance indicators	.232	.185	.085
Environmental key performance indicators	.129	.103	.119
Sum of mea square error	0.499	0.381	0.296

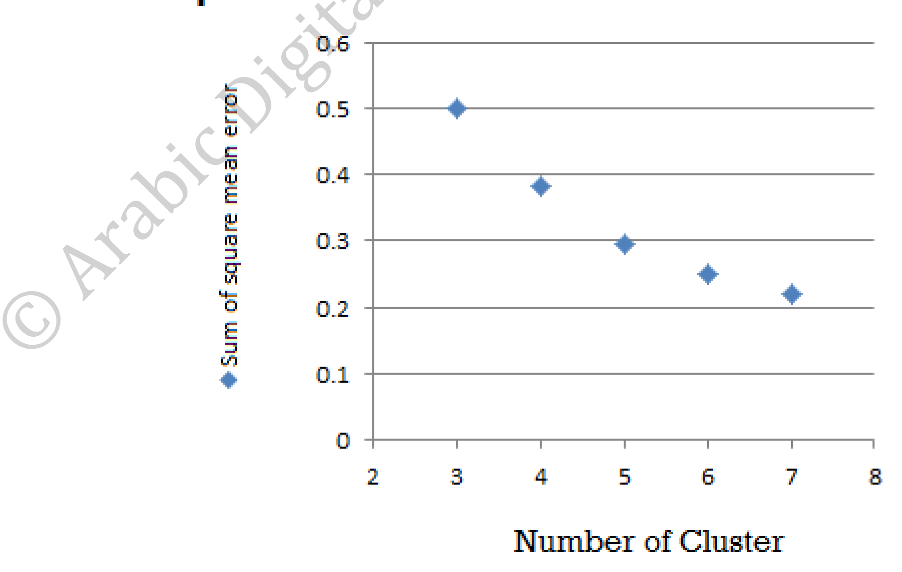


Figure (6-1): Optimal number of clusters

Figure (6-1) shows the rate of changes in mean square error was maximum at three clusters, so the optimal number of clusters is three.

Using K-mean cluster analysis in SPSS, the results show that there are three significant clusters according to the key performance indicators (environmental, operational and Economic or financial).

Table (6-2) Clusters of organizations according to key performance indicators				
	K-means cluster analysis of organization(*)			
Performance indicators	Cluster(1)**	Cluster(2)**	Cluster(3)**	ANOVA
Environmental Indicators	3.09*	**4.25***	3.20*	F=31.303 P=0.000
Operational Indicators	3.99*	**4.46***	0.43*	F=33.564 P=0.000
Economic Indicators	3.58*	**4.26***	2.89*	F=15.800 P=0.000

*Represents the average degree of importance attached to each Key Performance Indicators by cluster, importance is measured on a six-point scale. (Interval scale 0-5: 0=not at all and 5= very significantly)

the numbers in the parentheses indicate the number of cluster. The observed F-statistics were derived from one-way ANOVA and the p-values are associated with the observed F-statistics. Numbers in bold indicate the highest group centroid for that measure**

The table (6-2) shows there are three clusters of green manufacturing strategies, which are: **care-taker Environment, Agile Environment, and Lean Environment green strategy.**

Cluster number one called **care-taker Environment**, because the manufacturing firms in this cluster seeks to realize all key performance indicators (environmental, operational and Economic or financial) in moderate to high levels.

Cluster number two called **Agile Environment**, because K-mean values of this cluster were the highest among all the other groups relative to other clusters. So that this means the manufacturing firms in this cluster seeks to realize all key performance indicators (environmental, operational and Economic or financial) in a highly level.

Cluster number three called **Lean Environment**, because the K-mean values of this cluster indicated that the firms in this cluster seek to realize environmental key performance indicators, economic environmental key performance indicators in moderate manner, and lower degree of importance to operational key performance indicator.

So, the researcher achieves the fifth objective of the research: Clustering the manufacturing organization according to Key performance indicators in Jordan, using K-mean cluster analysis. And the results of this analysis show that there are three different clusters that are classified according to Key performance indicators called: **Care-Taker Environment, Agile Environment, and Lean Environment**. The following part will identify the significant actions made by the different clusters of manufacturing organization adopt ISO14001 standards in Jordan.

6-3 Identifying the significant actions made by the different clusters of manufacturing organization adopt ISO14001 standards in Jordan:

The researcher used average values to identify what are the actions made by the firms in each cluster, and what are the significant ones. Green operation actions in this research grouped into categories such as; green purchasing, internal commitment…etc.

6-3-1 Significant green operational actions made to realize key performance indicators

6-3-1.1 significant internal commitment actions

Table (6-3): significant internal commitment actions				
		Mean value		
#	**Action**	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	Commitment of top management and other levels for adopting and implementing the environmental management system.	**4.1** **H**	**4.875** **H**	**4** **H**
2.	Cross-functional cooperation for environmental improvements.	**3.9** **H**	**4.5** **H**	**4** **H**
3.	All departments and employees are fully involved in environmental management system.	**3.8** **H**	**4.625** **H**	**4** **H**
4.	Audits conducting for environmental management system at planned intervals.	**4.3** **H**	**4.875** **H**	**5** **H**
5.	All organizations departments and units met the requirements of ISO 14001	**4.2** **H**	**4.6875** **H**	**4** **H**
6.	The performance of environmental management system was measured and monitored on regularly basis (e.g. gas emissions, Waste water…etc) and a corrective actions were taken when exceeding the acceptable or legal limits.	**3.6** **H**	**4.875** **H**	**4** **H**
7.	Use of "green IT" (e.g. reduction of server number, use of green software, optimization of backup number).	2.3 L	**4.0625** **H**	3 M

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-3) contains the first category of green actions called **internal commitment**, which consists of 7th actions. The table shows that the first six actions of this category hold a high priority across all strategic groups (this means that all clusters implement these actions in a high level in their corporations), so these actions are significant across all clusters. While the last action (7th action) implement in different level across the strategic groups, but still significant only for agile environment according to its high priority.

(6-3) indicates that the majority of actions in this category are implemented in high degree by all strategic groups (agile, care-taker, and lean environment).

6-3-1.2 Significant Cooperation with suppliers: Green purchasing actions

Table (6-4): Significant Cooperation with suppliers: Green purchasing actions

		Mean value		
#	**Action**	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	Providing suppliers with material specifications in order to ensure environment friendly materials	**3.5** **H**	**4.125** **H**	**5** **H**
2.	Cooperation with suppliers for defining and achieving environmental objectives, targets and programs.	2.8 M	**4** **H**	**4** **H**
3.	Environmental audit are conducting for suppliers on regularly basis in order to ensure their compliance.	1.7 L	3.4375 M	**4** **H**
4.	Suppliers are ISO 14001 certified	1.1 L	1.625 L	**5** **H**
5.	Environmental management system for suppliers must be evaluated by third party such as JISM or Ministry of Environment	0.8 L	1.875 L	3 M

H: High level and also represent a significant action
M: Moderate level
L: Low level

Table (6-4) contains the second category of green actions called **Green purchasing**, which consists of 5[th] actions. It shows that lean environment performing the first four actions in this category in a high level, and this means these actions are a significant for this strategic group, while the first two actions are significant for agile environment, only the first action is significant for care-taker environment (the table shows that the first action are significant across all strategic group), and the other actions of this category are performing across cluster in a moderate and low levels.

The results show that lean environment also focused on this category of green actions, since it is performing the majority of the above actions in a high degree relative to other clusters.

6-3-1.3 Cooperation with customers: Customer Cooperation with environmental consideration

Table (6-5): Cooperation with customers: Customer Cooperation with environmental consideration

		Mean value		
#	Action	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	Consideration of customer feedback regarding environment management system	1.8 L	3.125 M	**5** **H**
2.	Cooperation with customers for cleaner production	1.1 L	2.5625 M	3 M
3.	Cooperation with customers for green packaging.	1 L	**3.5625** **H**	3 M

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-5) contains the third category of green actions called **Customer Cooperation with environmental consideration** which consists of three actions. The results show that care-taker environment implement the actions in this category in a low degree relative to other strategic groups which implement it in different degrees; where agile environment implement the third actions in a high degree (this means this action is a significant for agile environment), and the first action is a significant only for lean environment.

6-3-1.4 Eco-design and packaging actions

Table (6-6): Eco-design and packaging actions				
		Mean value		
#	Action	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	Design of products for reduced consumption of material/energy	3.2 M	**3.75** **H**	3 M
2.	Products are designed so that you need less energy when used by the customer.	1.6 L	3.3125 M	2 L
3.	Products are designed to be easily recycled.	1.5 L	3.4375 M	**4** **H**
4.	Products are designed to be easily benefit from some of the parts or materials constituent after consumption.	1.2 L	3.0625 M	**4** **H**
5.	Products are designed so that do not contain hazardous substances, kill or harm living organisms or ecological system.	2.6 M	**3.875** **H**	0 L
6.	products are designed so that less weight and size	2.1 L	3.4375 M	0 L
7.	Use of biodegradable materials.	2.6 M	3 M	0 L
8.	Packaging design for reduced environmental impact.	2.1 L	**3.5** **H**	0 L

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-6) contains the fourth category of green actions called **Eco-design and packaging actions**, which consists of eight actions. The results show that lean environment focused on two actions in a high degree, these actions related to designing

processes in corporations, in which the designers designate the end products in a way the corporation can recycle end-product and benefit from some of parts or materials constituent after consumption, these two actions were a significant for lean environment. In addition, the last four actions of this category didn't consider or perform completely by lean environment. In addition, the results show there are three significant actions for agile environment (because it performs them in a high degree), these actions are designing product for reducing the consumption of material/ energy and designing the products so that don't contains hazardous substances, kill or harm living organisms or ecological system, and design packaging for reduced environmental impact. The other actions are performed agile environment in a moderate level. While care-taker environment performed all actions in this category in a moderate and low levels.

6-3-1.5 Investment recovery actions

Table (6-7): Investment recovery actions

		Mean value		
#	Action	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	Investment recovery(sale) of excess inventories/materials	2.2 L	2.5 M	0 L
2.	Sale of scrap and used Materials	**3.7** **H**	**3.5** **H**	0 L
3.	Sale of excess capital equipment	2.6 M	3.125 M	0 L

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-7) contains the fifth category of green actions called **Investment recovery**, which consists of three actions. The results show that lean environment didn't perform or consider any action in this category. Also, shows that the second action (Sale of scrap and used Materials) performed by the agile and care-taker in a high level (this means this action is significant for these two strategic groups), and other actions in this category carried out in a moderate and a low levels by these two strategic groups.

6-3-1.6 Distribution strategies and transportation execution actions

Table (6-8): Distribution strategies and transportation execution actions

		Mean value		
#	Action	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	(Re) design of logistics system components for higher environmental efficiency.	1.6 L	**3.625 H**	3 M
2.	Organization location was considered for reducing environment impacts.	3.2 M	**4.4375 H**	**4 H**
3.	Use of alternative fuels or energy resources(Such as: fuel with a better quality (95 octane) instead of diesel)	1.6 L	3 M	3 M
4.	Clear environmental criteria defined for selecting the mode of shipment processes (Such as carbon dioxide emissions ... etc.)	2.1 L	**3.6875 H**	2 L
5.	Use new model of vehicles	2.8 M	**3.75 H**	**4 H**
6.	Use less polluting vehicles (such as the mass gasoline instead of diesel)	2.2 L	2.75 M	3 M
7.	Effective shipment consolidation and full	3.2	**4.25**	**4**

	vehicle loading	M	**H**	**H**
8.	Routing systems to minimize travel distances	**3.7** **H**	**4.375** **H**	**4** **H**
9.	Vehicles that have many malfunctions be disposed	2.9 M	**3.8125** **H**	**4** **H**
1(	Maintenance of vehicles are periodically	**4.2** **H**	**4.625** **H**	**4** **H**

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-8) contains the sixth category of green actions called **Distribution strategies and transportation execution**, which consists of ten actions. The results show that agile environment focused on this category of actions, since it carried out the majority of actions of this category at a high level (This means these actions are significant actions for this strategy group), and the other actions in this category carried out at a moderate level. Also, lean environment carried out sixth actions in this category at a high level, and shared the last four actions with lean environment based on the level of importance (High and significant), and the other actions in this category carried out at a modestly level by agile environment. On other hand care-taker environment carried out all actions in this category in a modestly level (in moderate and low level), except two of them are significant for this strategy group, these two actions related to maintenance a vehicle periodically and routing systems to minimize travel distances.

6-3-1.7 Warehousing and green building action

Table (6-9): Warehousing and green building action				
		Mean Value		
#	Action	**Care-taker environment**	**Agile environment**	**Lean environment**
1.	Attention to construction materials (e.g. use of recycled concrete, steel, asphalt and other materials).	1.2 L	2.8125 M	**4** **H**
2.	Thermal insulated building	3 M	**4** **H**	**4** **H**
3.	Day lighting (installing skylights and clerestory windows in distribution facilities allows companies to use natural light as a source of interior illumination)	2.6 M	3.125 M	3 M
4.	Energy- efficient lighting systems	**3.9** **H**	**3.75** **H**	3 M
5.	Energy- efficient material handling equipment	**3.5** **H**	**3.5** **H**	**4** **H**
6.	Use of alternative energy sources (e.g. solar or photovoltaic panels)	0.9 L	1.125 L	0 L
7.	Rainwater is collected for use in the plant operation	0.8 L	1.4375 L	0 L
8.	wastewater is recycled for use in irrigation of crops or any other acts do not need to clean water	**3.6** **H**	2.0625 L	0 L

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-9) contains the seventh category of green actions, which consists of eight actions. The results show that the strategic groups shared some of these actions at the same level of performance, such that the fifth action carried out at a high level across all

strategic groups, also the sixth and seventh actions carried out at low level by all strategic groups. Agile, care-taker, and lean environment has three different significant actions as shown in the previous table.

6-3-1.8 Reverse logistics actions

Table (6-10): Reverse logistics actions

#	Action	Mean Value		
		Care-taker environment	**Agile environment**	**Lean environment**
1	Wastes that are resulted from manufacturing process be collected and disposed in Environmentally safely.	**4.1** **H**	**4.9375** **H**	**4** **H**
2	Corrupted or consumed products are collected for recycling purposes.	3.3 M	**4.4375** **H**	**4** **H**
3	The organization is keen on achieving efficiency in resource investment.	**4.1** **H**	**4.375** **H**	**4** **H**
4	Corrupted or consumed products are collected to re-use some parts or materials their constituent.	2.8 M	**4.25** **H**	0 L
5	There are a locations for collecting the corrupted and consumed products.	**4.3** **H**	**4.6875** **H**	0 L
6	The location contains corrupted and consumed products are managed periodically.	3.4 M	**4.5625** **H**	0 L
7	The organization coordinate with the concern sector for disposing the corrupted and consumed product in less harm the environment.	3.4 M	**4.8125** **H**	**4** **H**

H: High level and also represent a significant action.
M: Moderate level
L: Low level

Table (6-10) contains the last category of green actions called **Reverse Logistics**, which consists of seventh actions. The results show that agile environment carried out all the category actions at a high level (that’s means all these actions in this category are

significant for agile environment). As shown in the results lean environment carried out four actions of this category at a high level, and the other actions at a low level (that's means it focused on this category of actions but not as agile environment). While three actions of this category carried out by care-taker environment at a high level (that's means these three actions in this category are significant for care-taker environment), the table indicates that the first action is a significant action across three strategic groups.

6-4 Evaluation performance realized by each strategic group

6-4-1Evaluation performance realized by each strategic group (Environmental performance)

Table (6-11) : Evaluation performance realized by each strategic group (Environmental performance)				
Mean Value of each cluster				
#	Performance realized type:	Care-taker environment	Agile environment	Lean environment
1.	Reduction of air emissions-Carbon dioxide, toxic gases, volatile organic compounds …etc.	2.1 L	**4** **H**	0 L
2.	Reduction of waste water.	2.7 M	**3.75** **H**	0 L
3.	Reduction of solid and hazardous wastes.	2.5 M	**4.125** **H**	**4** **H**
4.	Decrease of consumption for hazardous/harmful/toxic materials.	2.7 M	**4** **H**	**4** **H**
5.	Reduction the environmental impact due to traffic, motor vehicles and transport operations.	1.5 L	2.9375 M	0 L
6.	Improvement of transportation environmental	1.9	3.1875	**4**

	performance (e.g. lower fuel consumption)	L	M	**H**
7.	Adopting environmental criteria for the selection of contractors and suppliers (e.g. purchasing of materials that consist of less environmentally harmful elements).	1.8 L	2.875 M	**5** **H**
8.	Increasing the use of recyclable resources.	1.7 L	**3.5** **H**	**5** **H**
9.	Increasing the use of resources which can remanufacture.	1.8 L	**3.5** **H**	**5** **H**
10.	Percentage of the constituent parts or materials for products that have been reused	2 L	3.3125 M	**4** **H**

H: High performance, and also significant performance.
M: Moderate performance.
L: Low performance.

Table (6-11) contains the environmental performance realized by each strategic group (Agile, Care-taker, and Lean environment), which consists of ten indicators. The results show that lean environment realize a seventh environmental performance indicators at a high level (that's means these indicators are significant performance accordance to its high priority), and fourth indicators of these shared a high priority with agile environment. Also agile environment realize sixth indicators at a high level, and other indicators realized on moderate level, while Care-taker environment realized the all environmental indicators at moderate and low levels.

6-4-2 Evaluation performance realized by each strategic group (Operational performance)

Table (6-12) : Evaluation performance realized by each strategic group(Operational performance)				
Mean Value of each cluster				
#	Performance realized type:	Care-taker environment	Agile environment	Lean environment
1.	Increase amount of goods delivered on time	2.6 M	**3.6875** **H**	3 M
2.	Decrease inventory levels.	2.1 L	**3.5625** **H**	0 L
3.	Decrease scrap rate.	2.5 M	**3.75** **H**	0 L
4.	Promote products' quality.	3.1 M	**4.0625** **H**	0 L
5.	Increased product types.	2.9 M	**3.625** **H**	0 L
6.	Increase productivity	2.8 M	3.4375 M	0 L
7.	Improved capacity and utilization.	2.9 M	**3.6875** **H**	0 L

H: High performance, and also significant performance.
M: Moderate performance.
L: Low performance.

Table (6-12) contains the operational indicators realize by each strategic group, which consist of seventh indicators. The results show agile environment realized all operational performance indicators at a high level (that means all operational performance indicators are significant for agile environment). Lean environment realized only the first indicator at a moderate level. While care-taker environment realize the majority of operational performance indicators at a moderate level.

6-4-3 Evaluation performance realized by each strategic group (Economic, Financial and performance)

Table (6-13) : Evaluation performance realized by each strategic group(Economic(Financial) performance)				
Mean Value of each cluster				
#	Performance realized type:	Care-taker environment	Agile environment	Lean environment
1.	Decrease the cost of raw materials	2.4 L	3.125 M	2 L
2.	Decrease the cost of energy consumption.	2.4 L	3.1875 M	**4** **H**
3.	Decrease the fees for waste treatment.	1.5 L	3.125 M	**4** **H**
4.	Decrease of fee for waste discharge.	1.9 L	3 M	3 M
5.	Decrease of operational cost.	2.4 L	3.3125 M	1 L
6.	Decrease cost of purchasing for environmentally friendly materials.	1.2 L	2.75 M	1 L
7.	Increase the Market share.	2.8 M	3 M	0 L
8.	Increase of revenues.	2.9 M	3.1875 M	1 L
9.	Decease of fees due to environmental accidents.	2.4 L	**4.25** **H**	0 L

H: High performance, and also significant performance.
M: Moderate performance.
L: Low performance.

Table (6-13) contains economic (or financial) performance indicators, which consists of nine indicators. The results show that lean environment realized two indicators at a high

level (that means these two indicators are significant for lean environment), and the majority of other indicators realized at low level. On other hand agile environment realized only the last indicator in table (6-13) at high level, and the other indicators realized at moderate level, while care-taker realized the majority of financial indicators at low level.

6-5 Strategic patterns pictorial representations

After grouping the green strategies of Jordanian manufacturing firms that adopt ISO14001 using K-mean clustering analysis, the result shown there are three clusters or strategic groups called Agile, Care-taker, and Lean environment according to Key performance indicators that they seeks to realize. Then the significant actions and performance indicators for each cluster or strategic group are determine according to high priority that the actions or performance indicators holds.

Finally, the results illustrate there are two clear and consistent patterns of green manufacturing strategies of Jordanian manufacturing firms that adopt ISO14001. The first pattern called Agile Environment, this pattern seeks to realize all types of indicators (environmental, operational, and economic) at a high level, because their continuous improvement process in all areas of environment. Figures (6-2, 6-3) represent Agile pattern.

While the other pattern called Lean Environment which seeks for both cost cutting strategy and to achieve the minimal requirement for ISO 14001 requirements. Figures (6-4, 6-5) represent Lean pattern.

On other hand, care taker cluster doesn’t have a clear strategic pattern.

As discussed above the following figures illustrate each pattern in terms of the significant green actions that adopted by the firms in each pattern, also the significant performance indicators realized by the firms in each pattern. The following figures are pictorial representations for two different patterns (Agile and lean environment)

According to the first level of figure (6-2, 6-4) presents the pattern name, the second level show the green operation actions categories (e.g. green operations, internal commitment …etc.), and the last level is green operation actions

The first level of figure (6-3, and 6-5) presents the pattern name, the second level shows performance indicators categories (e.g. environmental performance, economic performance…etc.), and the last level is performance indicators.

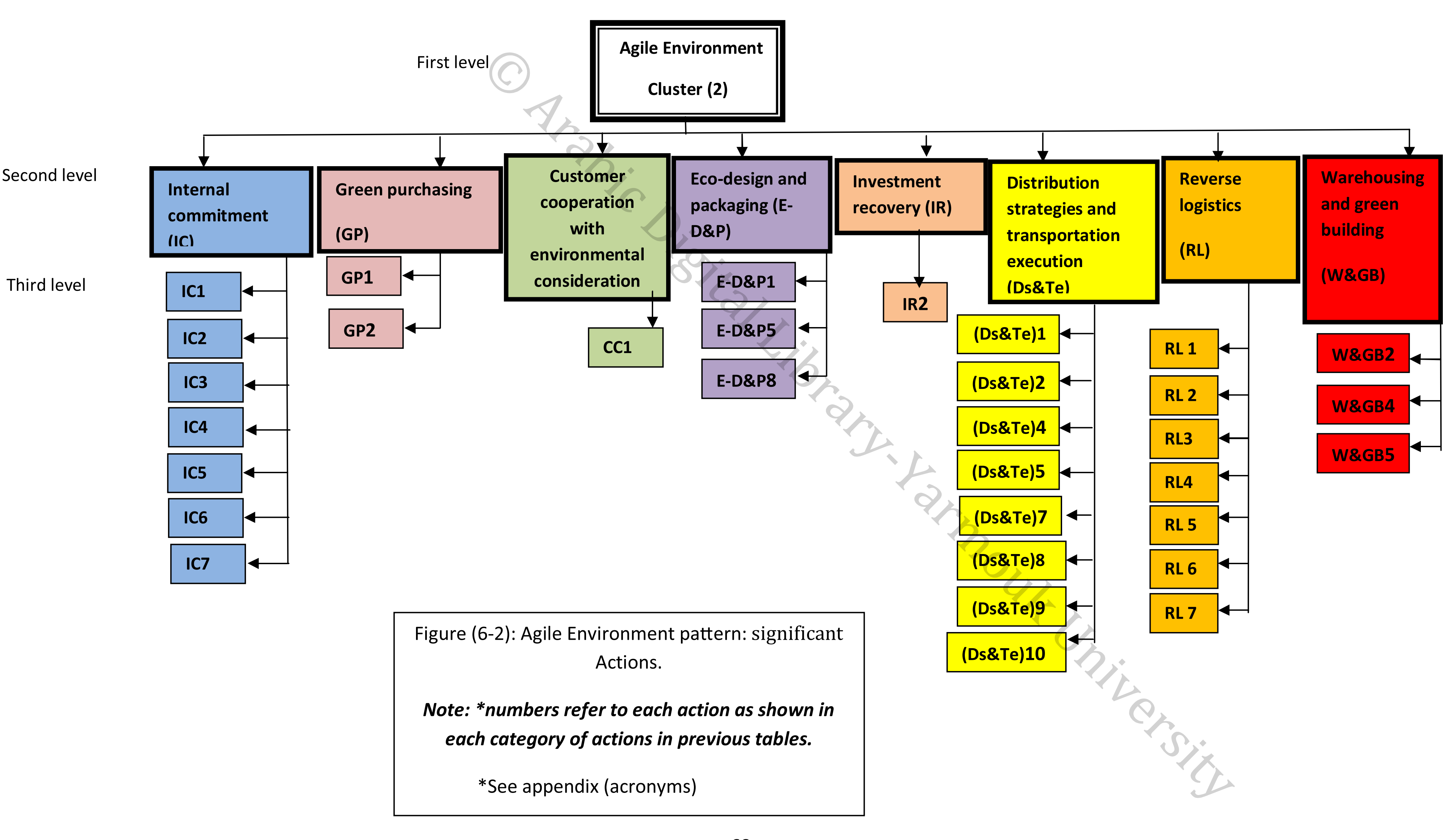


Figure (6-2): Agile Environment pattern: significant Actions.

Note: *numbers refer to each action as shown in each category of actions in previous tables.

*See appendix (acronyms)

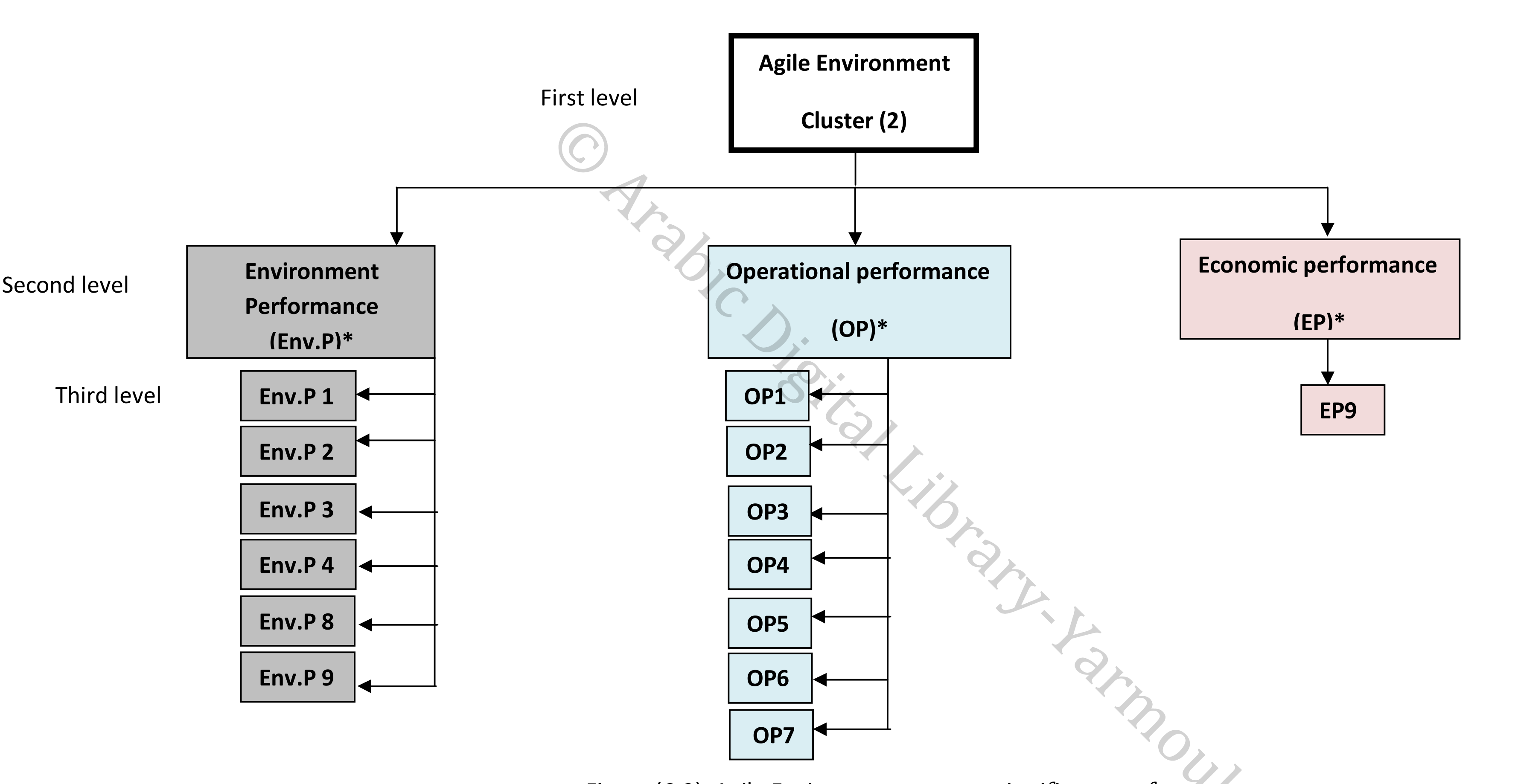


Figure (6-3): Agile Environment pattern: significant performance indicators.

Note: * numbers refer to each action as shown in each category of actions in previous tables.

*See appendix (acronyms)

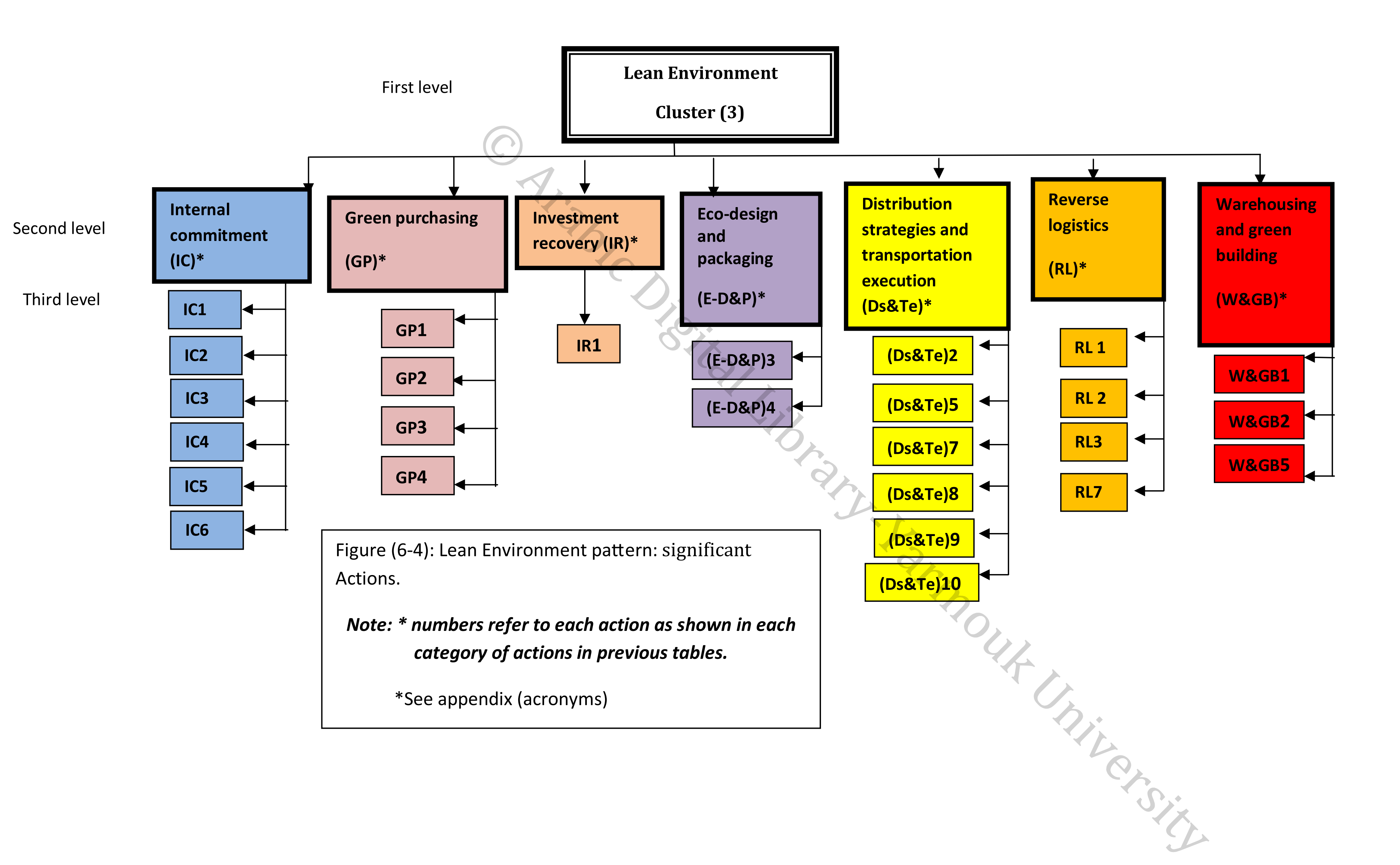


Figure (6-4): Lean Environment pattern: significant Actions.

Note: * numbers refer to each action as shown in each category of actions in previous tables.

*See appendix (acronyms)

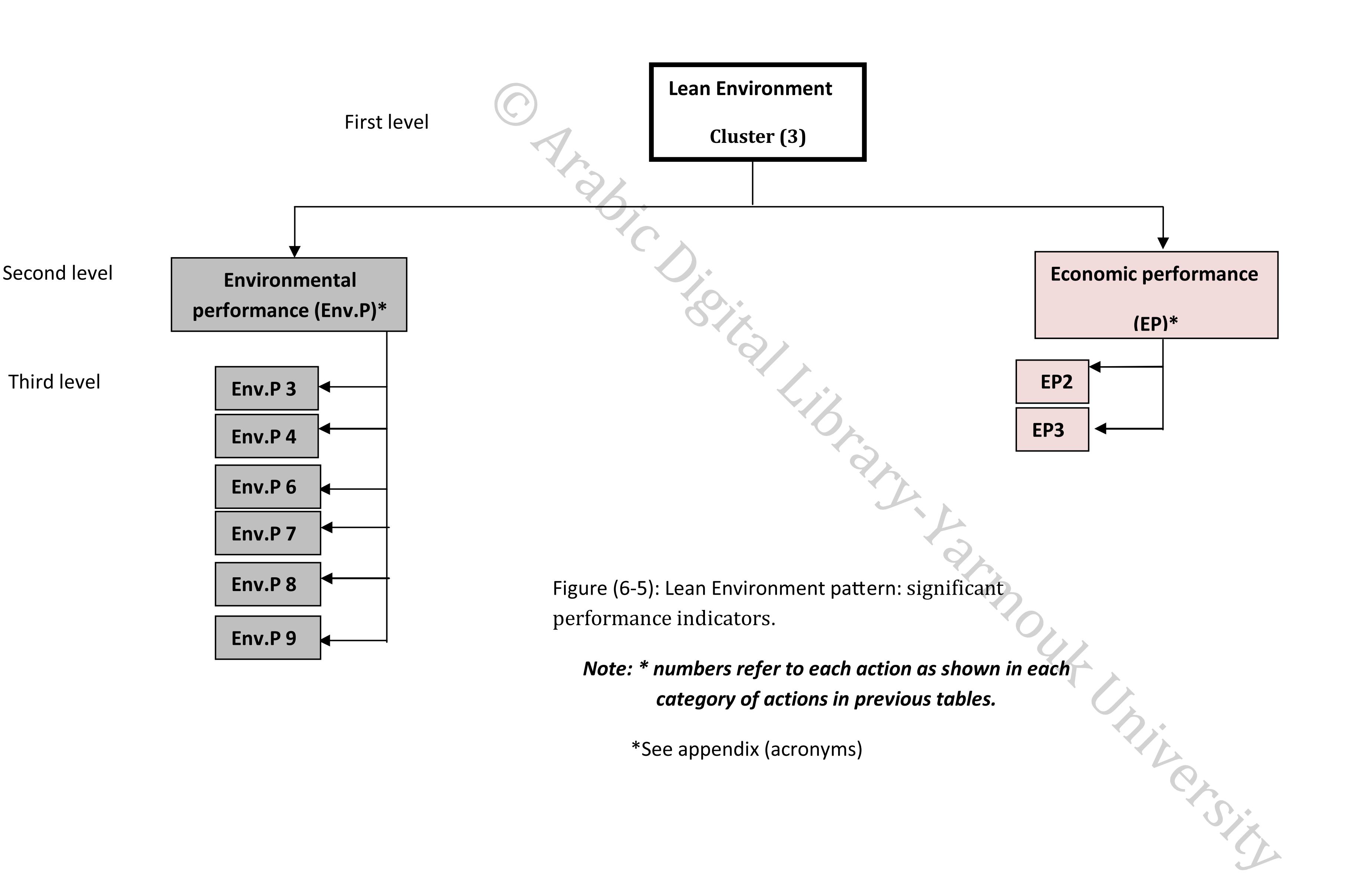


Figure (6-5): Lean Environment pattern: significant performance indicators.

Note: * numbers refer to each action as shown in each category of actions in previous tables.

*See appendix (acronyms)

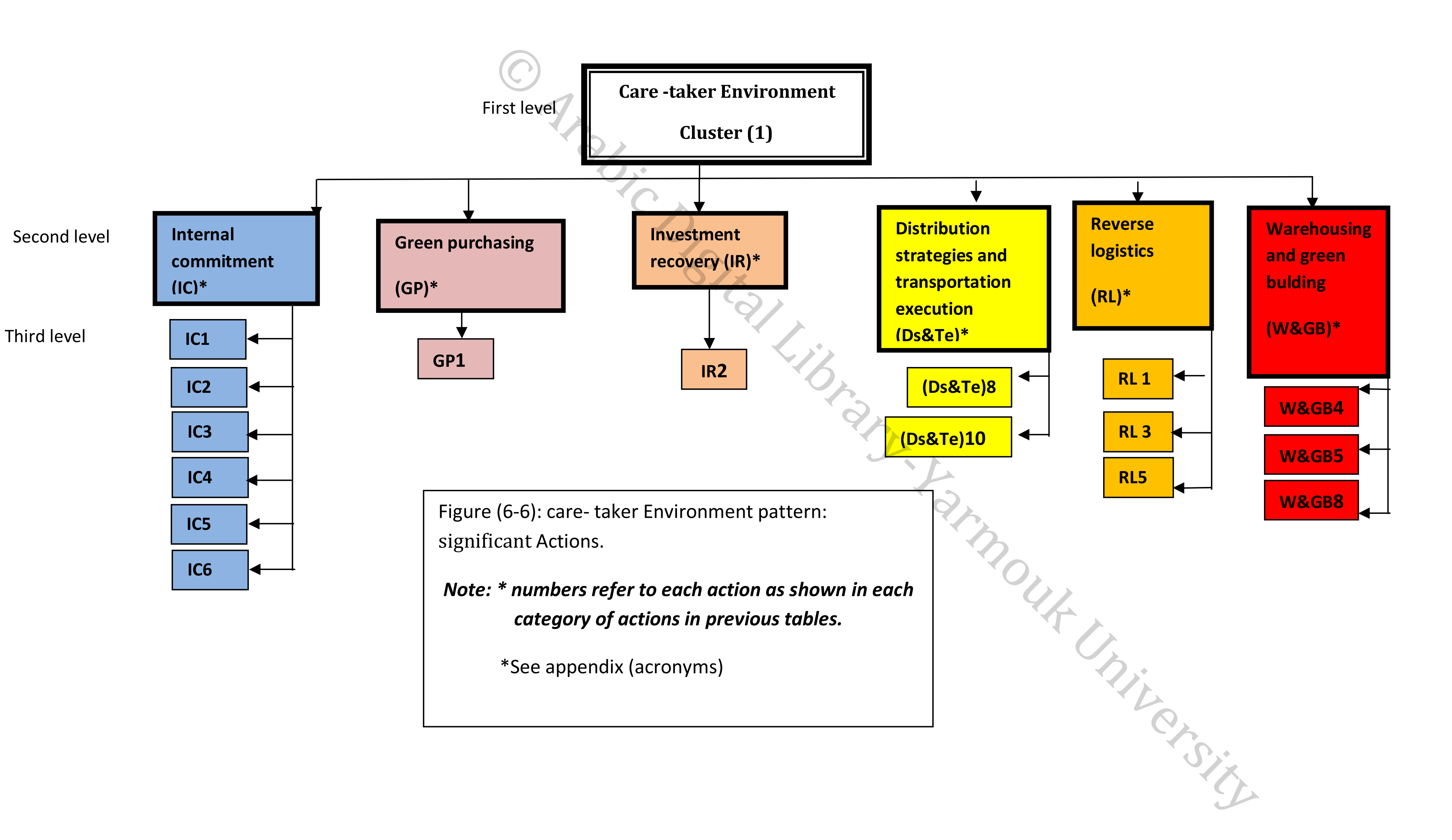


Figure (6-6): care- taker Environment pattern: significant Actions.

Note: * numbers refer to each action as shown in each category of actions in previous tables.

*See appendix (acronyms)

6-6 Summary:

There are three significant clusters of green manufacturing strategies according to key performance Indicators (environmental, Operational, and Economic (financial)).These clusters are:

1. Agile Environment.
2. Care-taker.
3. Lean Environment.

❖ **The manufacturing firms in Agile environment cluster :**

- Seek to realize all key performance indicators in a high level.
- Adopt the majority of green operation actions in their operation at a high level in order to achieve key performance indicators.
- Realized significant performance indicators in a high level.

❖ **The manufacturing firms in Care-taker environment cluster :**

- Seek to realize all key performance indicators in moderate to high level.
- Adopt six categories of green actions at a high level in order to achieve key performance indicators.
- Realized performance indicators at low to moderate level.

❖ **The manufacturing firms in Lean Environment cluster :**

- Seek to realize environmental and economic (financial) key performance indicators in a moderate level.
- Adopt the majority of green operation actions in their operation at a high level in order to achieve key performance indicators.

- Realized significant performance indicators in two areas, environmental and economic.

  Finally, strategic patterns pictorial representations section illustrate there are two consistent strategic patterns of green manufacturing strategies in Jordanian (see figure 6-2, 3, 4, 5, 6):

- Agile environment
- Lean environment

Chapter 7: Discussion, conclusions and applications

7-1 Introduction:

This chapter is separated into three main sections: discussion; conclusion of the research, and finally the application and limitation of research.

7-2 Discussion:

This section discusses the realized grouping or clustering of green strategies of Jordanian manufacturing that adopt ISO14001 according to Agile Environment, Care-taker Environment, and Lean Environment, significant actions and significant performance indicators for each cluster.

7-2-1 clusters (strategic groups)

- **Why three clusters are the optimal number of grouping of Jordanian green manufacturing firms that adopt ISO14001?**

  The manufacturing firms clustered or grouped by using SPSS K-means cluster analysis technique, as mentioned in chapter (6) several trial and errors done to estimate the optimal clusters with 10 iterations. Optimal numbers of clusters identified with three clusters. (See chapter (6), table (6-2) shows the result of this analysis).

  Also, the explanations in which why three clusters is the optimal number of green manufacturing strategies is to: Statistically, the maximum rate of changes in sum mean square error determines the optimal number of cluster needed where the noise is minimal. (See chapter (6), figure (6-1) that illustrates in three

clusters, where rate of changes in mean square error was the maximum, so, this is the reason why three clusters is the optimal).

- **Reasons behind titles (Agile, Care-taker, and Lean environment)**

According to the key performance indicators (environmental, operational and Economic or financial), the manufacturing firms grouping Using K-mean cluster analysis in SPSS, the results show that there are three significant clusters called Agile, Care-taker, and Lean environment.

As shown in chapter (6) Cluster number one called care-taker Environment, because the manufacturing firms in this cluster seeks to realize all key performance indicators (environmental, operational and Economic or financial) in moderate to high level.

Cluster number two called Agile Environment, because the manufacturing firms in this cluster seeks to realize all key performance indicators (environmental, operational and Economic or financial) in a highly level. because their continuous improvement process in all areas of environment.

Cluster number three called Lean Environment, because the firms in this cluster seek to realize environmental key performance indicators, economic environmental key performance indicators in moderate manner, and lower degree of importance to operational key performance indicator. In other words which seeks for both cost cutting strategy and to achieve the minimal requirement for ISO 14001 requirements.

7-2-2 significant actions

Green actions in this research classified into eight categories (e.g. internal commitment, green purchasing…etc.), each cluster or strategy group carried out each category of actions in a different levels.

The presentations of significant actions for each cluster or strategic group were presented in chapter (6).

As mentioned in chapter (6) agile environment seeks to continual improve their environmental aspect by realizing its all key performance indicators in a high level. So that the majority of significant actions were in this strategy group (cluster 2); that means agile environment adopts green actions in a high way in order to achieve or realize performance indicators (See chapter (6), figure (6-2)). On other hand, lean environment seeks to realize both environmental and economic key performance indicators and not taking in consideration the operational indicators, so that it focused on a set of green actions from the majority of categories and implement it in a high level relative to other strategic groups, these actions are significant for this strategic group or cluster 3. (See chapter (6), figure (6-4)).

In construct, care-taker seeks to realize all key performance indicators in a moderate level, and adopts sets of green actions in a high level in order to achieve indicators(See chapter (6), figure (6-6)).

7-2-3 significant performance indicators

Performance indicators in this research classified into three dimensions or areas; environment, operational, and economic (financial).

Lean environment realized a significant performance in two areas, Environmental and economic. This could be justified to the objectives or key performance indicators of this strategy group that intended to realize, the results or performance realized by this strategy group are consistent with its objectives, in which this strategy group neglected the key operational indicators and also it didn't achieve or realize significant operational performance.

While agile environment realized a significant performance indicators in all areas or dimensions; environmental, operational, and economic (financial), also could be justified that this strategy group intended to realize all key performance indicators in a high level and the results or the realized performance are consistent its objectives.

Care-taker environment realized performance in low and moderate level, this could be justified the firms in this cluster or strategy group are still working in progress on achieving key performance indicators.

7-3 Conclusion

There are two clear patterns of green manufacturing strategies called agile environment and lean environment.

Agile environment intended to realize all key performance indicators in a high level, also adopts the majority of green actions in a high level, thus it achieved or realized performance in all areas in a high level.

While lean environment focused only on two performance indicators (environmental and financial) and adopt sets of green actions in a high level, and finally, it realized performance in these two areas. The operational performance neglected by this strategy group.

There is no clear pattern to care-taker environment, this could be justified that these firms in this cluster or strategy group are still working in progress to realize the key performance indicators through implementing green actions.

7-4 Main research contributions

- This is the first study in the Middle East that addressed the green manufacturing strategic patterns in consideration.
- The methodology used in this research is unique, since the researcher used K-mean clustering analysis.
- The previous studies have not addressed the significant actions and performance indicators in details. Also the previous studies did not cluster or group the manufacturing firms based on KPIs.
- The titles of green strategic patterns are unique, which have not addressed by the previous studies.
- This research proposed three clusters of green manufacturing strategy; and also found new terminologies in green operation management; Agile Environment, Care-taker environment, and Lean environment.
- Also the research proposed two clear patterns of green manufacturing strategies.
- This research covers all supply chain management practices, for accuracy and holistic view in business operation.

7-5 Main recommendations (Applications)

- This research reported with different alternatives of green manufacturing strategies in Jordan.
- The reported effective strategic patterns can be adopted by the manufacturing and consultation firms in the future.

7-6 Main limitation of research

- The researcher was unable to develop a prediction model because the sample size is too small.
- Some of the granted firms in Jordan have reservation to disclose their clients' information, so the researcher couldn't reach the total population.

7-7 Future research:

The three clusters of green manufacturing strategy prediction models developed reflect groups of the Jordanian manufacturing firms that adopt ISO14001 which were reported for 27 firms, so the prediction models developed in this research are still indicative models. Their external validity could be examined by conducting further researches in other developing countries that have large sample size to be able to generalize the results. Also, the future research can study the relationship between green strategy groups and the kind of industries, the age of the firms, and other organizational characteristics.

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Appendix A



Yarmouk University

Business Administration Department

The researcher conducted An Empirical Study entitled "**The Evaluation of Green Manufacturing Strategies adopted by ISO 14001 Certificate Holders in Jordan"** In order to complement the requirements for obtaining a master's degree in business administration from Yarmouk University.

This study aims to Using the literature to operationally define the Key Performance Indicators, Green Actions, and Performance Indicators, Identifying the green operations actions made by the manufacturing organizations realized ISO 14001 standards in Jordan, Identifying the Performance indicators realized by the manufacturing organizations realized ISO 14001 standards in Jordan, Clustering the manufacturing organization according to Key Performance Indicators in Jordan, Identifying the significant actions made by the different clusters of

manufacturing organization realized ISO 14001 standards in Jordan in order to know What are the effective and ineffective green manufacturing strategies adopted by the ISO 14001 holders in Jordan?

This study will identify the different green manufacturing strategies patterns adopted by ISO 14001 in Jordan. Since majority of previous studies focused on the motivation, the barriers and the successful implementation of ISO 14001, however, the effective manufacturing patterns adopted by ISO14001 holders is a limited research issue, further, the previous studies did not make clusters of organizations and developed strategy patterns of green manufacturing strategies, furthermore, the majority of previous studies surveyed organizations in developed or in transitions countries.

Questions are organized into four Main sections; the first section includes the general information about the organization and the respondents. The second section encompasses questions regarding the level of importance about taking organization's performance indicators into consideration in term of strategic orientation. The third section includes questions concerning the green supply chain practices that the organization carries out. The last section includes questions addressing the relationship between green supply chain practices adoption and the organization performance.

In this research, the term green manufacturing strategy content is classified into two main parts; the actions and competitive priorities. The actions are the tactics made by the organizations (Representative in the third Section); however the competitive priorities are the strategic key performance indicators which are the same as the business level strategy (Representative in the second Section).

The researcher is pleased to put between your hands the attached questionnaire, in the hope that you will answer to all paragraphs ticking (x) over the alternative, which is your answer. Note that your answer will be treated confidentially and used only for the purposes of scientific research.

The first section: General information about the organization:

❖ **Please select the area of the work of your organization:**

- Therapeutic industries and medical supplies
- Plastic and rubber industries
- Chemical industries and cosmetic preparations
- Engineering, electrical and information technology industries
- Wood and furniture industries
- Construction industries
- Packaging, paper, carton, and office equipments industries
- Food, agricultural and animal stock industries
- Textile and readymade Garments industries
- Mining industries.

- **Please determine the size (employees) your organization using employment levels:**
  - 1-4
  - 5-19
  - 20-99
  - 100-200
  - 201-300
  - 301-400
  - 401-500
  - >500
- **Firm's primary business goal in supply chain**
  - First-tier supplier to major firms
  - Second-tier supplier
  - Supplier to government
  - other

- **Please specify the year getting the ISO 14001 certification: ………………..**

The first section: General information about the respondents:

- **Please specify your job title: ………………**
- **Please specify your age: ……………….**
- **Please specify your educational path: ……………**
- **Please specify your general experience: …………………**
- **Please specify your experience in environmental management system…….**

- **Gender : ☐ male ☐ female**

Thank you for your honest cooperation and contribution in the completion of this survey.

Researcher:
Dua'a Sameeh Al_zagaibeh

Section #2: Performance indicators/ objectives

Please select the importance of the following indicators of the company according to what is documented in the Guide to Environmental Quality (ISO 14001).

Serial	Paragraph	Taken very significantly	Taken significantly	Taken a medium degree	Taken a low degree	Taken a very low degree	Not at all
Environmental indicator							
1	Reduction of air emissions-Carbon dioxide, toxic gases, volatile organic compounds …etc.						
2	Reduction of waste water						
3	Reduction of solid and hazardous wastes.						
4	Decrease of consumption for hazardous/harmful/toxic materials.						
5	Reduction the environmental impact due to traffic, motor vehicles and transport operations						
6	Improvement of transportation environmental performance (e.g. lower fuel consumption)						
7	Adopting environmental criteria for the selection of contractors and suppliers (e.g. purchasing of materials that consist of less environmentally harmful elements).						
Serial	**Paragraph**	**Taken very significantly**	**Taken significantly**	**Taken a medium degree**	**Taken a low degree**	**Taken a very low degree**	**Not at all**
8	Increasing the use of recyclable resources						

9	Increasing the use of resources which can remanufacture						
10	Re-use of the component parts of materials or products						
	Operational performance						
11	Increase amount of goods delivered on time.						
12	Decrease inventory levels.						
13	Decrease scrap rate						
14	Promote products' quality.						
15	Increased product types.						
16	Increase the productivity						
Serial	**Paragraph**	**Taken very significantly**	**Taken significantly**	**Taken a medium degree**	**Taken a low degree**	**Taken a very low degree**	**Not at all**
17	Improved the capacity and utilization.						
	Economic (Financial) performance						
18	Decrease the cost of raw materials						
19	Decrease the cost of energy consumption.						
20	Decrease the fees for waste treatment.						
21	Decrease of fee for waste discharge.						

22	Decrease of operational cost.						
23	Decrease cost of purchasing for environmentally friendly materials.						
24	Increase the Market share.						
25	Increase of revenues.						
26	Decease of fees due to environmental accidents.						

Section#3: Measure the level of applying green practices

Please select which of the following practices applied or implemented in your company to ensure proper compliance with the Specification 14001.

Serial	Paragraph	Extremely high	High	moderate	low	extremely low	Not considering at all
internal environmental management							
1.	Commitment of top management for adopting and implementing the environmental management system						
2.	Cross-functional cooperation for environmental improvements.						
3.	All departments and employees are fully involved in environmental management system						
4.	Audits conducting for environmental management system at planned intervals						
5.	All organizations departments and units met the requirements of ISO 14001.						

	The performance of environmental management system was measured and monitored on regularly basis (e.g. gas emissions, Waste water…etc) and a corrective actions were taken when exceeding the acceptable or legal limits.						
Serial	**Paragraph**	**Extremely high**	**High**	**moderate**	**low**	**extremely low**	**Not considering at all**
7.	Use of "green IT" (e.g. reduction of server number, use of green software, optimization of backup number).						
Cooperation with suppliers :Green Purchasing							
8.	Providing suppliers with material specifications in order to ensure environment friendly materials.						
9.	Cooperation with suppliers for defining and achieving environmental objectives, targets and programs.						
10.	Environmental audit are conducting for suppliers on regularly basis in order to ensure their compliance						
11.	Suppliers are ISO 14001 certified.						
12.	Environmental management system for suppliers must be evaluated by third party such as JISM or Ministry of Environment.						
Cooperation with customers: Customer Cooperation with environmental consideration							
13.	Consideration of customer feedback regarding environment management system						
14.	Cooperation with customers for cleaner production						
15.	Cooperation with customers for green packaging						

Serial	Paragraph	Extremely high	High	moderate	low	extremely low	Not considering at all
Eco-design and packaging							
16.	Design of products for reduced consumption of material/energy						
17.	Products are designed so that you need less energy when used by the customer						
18.	Products are designed to be easily recycled						
19.	Products are designed to be easily benefit from some of the parts or materials constituent after consumption						
20.	products are designed so that do not contain hazardous substances, kill or harm living organisms or ecological system						
21.	products are designed so that less weight and size						
22.	use of biodegradable materials						
23.	Packaging design for reduced environmental impact						
Investment recovery							
24.	Investment recovery(sale) of excess inventories/materials						
25.	Sale of scrap and used Materials						
26.	Sale of excess capital equipment						

Serial	Paragraph	Extremely high	High	moderate	low	extremely low	Not considering at all
Distribution strategies and transportation execution							
27.	(Re) design of logistics system components for higher environmental efficiency						
28.	Organization location was considered for reducing environment impacts						
29.	Use of alternative fuels or energy resources(Such as: fuel with a better quality (95 octane) instead of diesel)						
30.	Clear environmental						

	criteria defined for selecting the mode of shipment processes (Such as carbon dioxide emissions ... etc.)						
31.	Use new model of vehicles						
32.	Use less polluting vehicles (such as the mass gasoline instead of diesel)						
33.	Effective shipment consolidation and full vehicle loading						
34.	Routing systems to minimize travel distances						
35.	Vehicles that have many malfunctions be disposed						
36.	Maintenance of vehicles are periodically						
Serial	**Paragraph**	**Extremely high**	**High**	**moderate**	**low**	**extremely low**	**Not considering at all**
Warehousing and green building							
37.	Attention to construction materials (e.g. use of recycled concrete, steel, asphalt and other materials)						
38.	Thermal insulated building						
39.	Day lighting (installing skylights and clerestory windows in distribution facilities allows companies to use natural light as a source of interior illumination)						
40.	Energy- efficient lighting systems						
41.	Energy- efficient material handling equipment						
42.	Use of alternative energy sources (e.g. solar or photovoltaic panels)						
43.	Rainwater is collected for use in the plant operation						
44.	wastewater is recycled for use in irrigation of crops or any other acts do not need to clean water						

Serial	Paragraph	Extremely high	high	moderate	low	extremely low	Not considering at all
Reverse logistics							
45.	wastes that are resulted from manufacturing process be collected and disposed in Environmentally safe manner						
46.	corrupted or consumed products are collected for recycling purposes						
47.	The organization is keen on achieving efficiency in resource investment						
48.	corrupted or consumed products are collected to re-use some parts or materials their constituent						
49.	There are a locations for collecting the corrupted and consumed products						
50.	The location contains corrupted and consumed products are managed periodically						
51.	The organization coordinate with the concern sector for disposing the corrupted and consumed product in less harm the environment						

Section#4: **Measure the effect of applying green actions/practices on firms' performance**

Please specify the current level of performance in your company that resulted by adopting ISO 14001; in accordance with the following indicators:

serial	Paragraph	Very significantly	significantly	moderate	Low	Very low	Not at all
		81-100%	**61-80%**	**41-60%**	**21-40%**	**1-21%**	**0%**
Environmental indicator							
1	Reduction of air emissions-Carbon dioxide, toxic gases, volatile organic compounds …etc.						
2	Reduction of waste water						
3	Reduction of solid and hazardous wastes.						
4	Decrease of consumption for hazardous/harmful/ toxic materials.						
5	Reduction the environmental impact due to traffic, motor vehicles and transport operations						
6	Improvement of transportation environmental performance (e.g. lower fuel consumption)						
7	Adopting environmental criteria for the selection of contractors and suppliers (e.g. purchasing of materials that consist of less environmentally harmful elements).						

serial	Paragraph	Very significantly	significantly	moderate	Low	Very low	Not at all
		81-100%	**61-80%**	**41-60%**	**21-40%**	**1-20%**	**0%**
8	Increasing the use of recyclable resources						
9	Increasing the use of resources which can						

	remanufacture						
10	Percentage of the constituent parts or materials for products that have been reused						
Operational performance							
11	Increase amount of goods delivered on time						
12	Decrease inventory levels						
13	Decrease scrap rate						
14	Promote products' quality						
15	Increased product types						
16	Increase productivity						
17	Improved capacity and utilization.						
Economic (Financial) performance							
18	Decrease the cost of raw materials						
19	Decrease the cost of energy consumption.						
20	Decrease the fees for waste treatment.						
serial	**Paragraph**	**Very significantly**	**significantly**	**moderate**	**Low**	**Very low**	**Not at all**
		81-100%	**61-80%**	**41-60%**	**21-40%**	**1-20%**	**0%**
21	Decrease of fee for waste discharge.						
22	Decrease of operational cost.						
23	Decrease cost of purchasing for environmentally friendly materials.						
24	Increase the Market share.						
25	Increase of revenues.						
26	Decease of fees due to environmental accidents.						



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!Njǂƚ ƫƙƟƑƓǁƸ ƃƸƥƜƓ ƫƨƸƥơ ƇƸƉǞƸǏƇ ƫǀƸƉơǏƇ "ƇƸǂNjǀƴƓ **تقييم إستراتيجيات التصنيع الخضراء للمنظمات الحاصلة على شهادة الجودة (الايزو 14001) في الأردن" وذلك استكمالاً لمتطلبات الحصول على درجة الماجستير في ادارة الأعمال من جامعة اليرموك.**

وتهدف هذه الدراسة الى الرجوع الى الدراسات السابقة وذلك للحصول على تعريف للمتغيرات الريسية لهذا البحث (مؤشرات الأداء الأساسية، الأنشطة الخضراء في سلسلة التوريد، مؤشرات الأداء المتحقق)، تحديد النشاطات التشغيلية الخضراء التي تم تنفيذها من قبل المنظمات الصناعية الأردنية والحاصلة على شهادة (الأيزو 14001) ومدى تنفيذ تلك النشاطات،التعرف على الأداء المتحقق للمنظمات الصناعية والحاصلة على شهادة (الأيزو14001)، تصنيف المنظمات الصناعية الاردنية الى مجموعات وفقاً لمؤشرات الأداء الأساسية و التعرف على النشاطات المهمة لكل مجموعة من المنظمات الصناعية الأردنية والحاصلة على شهادة (الأيزو14001) في الأردن

سوف يتم تحديد أنماط الاستراتيجيات الخضراء المختلفة والمتبعة من قبل الايزو 14001 في الأردن. حيث أن معظم الدراسات السابقة ركزت على الدوافع، المعيقات، و التجارب الناجحة لتنفيذ أو تبني (الأيزو 14001) ، ومع ذلك فإن الدراسات السابقة حول أنماط استراتيجيات التصنيع الخضراء الفعالة محدود جداً حسب علم الباحثة. كما أن الدراسات السابقة لم تقم بتصنيف المنظمات أو قامت بتطوير أنماط لإستراتيجيات التصنيع الخضراء. وعلاوة على ذلك، أغلب الدراسات السابقة قد أجريت في البلدان المتقدمة ولم تتطرق للدول النامية.

تتكون أداة الاستقصاء (الاستبانة) من أربعة أجزاء رئيسية; الجزء الأول يتضمن معلومات عامة عن كل من المنظمة والمستجيب. الجزء الثاني يتضمن أسئلة حول تحديد مستوى أهمية المؤشرات (البيئية، التشغيلية والمالية) للمنظمات وفقاً لما هو موثق في دليل الجودة البيئية (الأيزو 14001) من وجهة نظر استراتيجية. الجزء الثالث يتضمن أسئلة حول تحديد مستوى تنفيذ الممارسات/المشاطات الخضراء في المنظمات الصناعية الأردنية وذلك لضمان حسن المطابقة مع مواصفة 14001. الجزء الرابع والأخير يتضمن أسئلة حول تحديد مستوى الأداء الحالي نتيجة لتطبيق مواصفة الجودة الأيزو 14001،وذلك وفقاً للمؤشرات المذكورة في الجزء الأول (البيئية، التشغيلية، المالية).

وقد عرفت الباحثة في هذه الدراسة، مضمون استراتيجية التصنيع الخضراء بأنها تتكون من جزأين رئيسين; الممارسات/النشاطات والأولويات التنافسية. حيث تتضمن الأوليات التنافسية مؤشرات الأداء الاستراتيجية (والممثلة في الجزء الثاني من الاستبانة). بينما تتضمن الممارسات/الأنشطة الخضراء التي يتم تنفيذها من قبل المؤسسة (والممثلة في الجزء الثالث من الاستبانة).

الجزء الأول:معلومات عامة عن المنظمة

☒ الرجاء اختيار نطاق عمل شركتكم :

- الصناعات العلاجية واللوازم الطبية
- الصناعات البلاستيكية والمطاطية
- الصناعات الكيماوية ومستحضرات التجميل
- الصناعات الهندسية والكهربائية وتكنولوجيا المعلومات
- الصناعات الخشبية والأثاث
- الصناعات الإنشائية
- التعبئة والتغليف والورق والكرتون واللوازم المكتبية
- الصناعات التموينية والغذائية والزراعية والثروة الحيوانية
- الصناعات الجلدية والمحيكات
- الصناعات التعدينية

☒ الرجاء تحديد حجم شركتكم وفقاً لعدد الموظفين:

- 4-1
- 19-5
- 99-20
- 200-100
- 300-201
- 400-301
- 500-401
- أكبر من 500

☒ الرجاء تحديد سنة الحصول على شهادة (الأيزو14001): ....

☒ الرجاء تحديد الهدف الأساسي للعمل في سلسلة التوريد:

- المورد من الدرجة الأولى لأغلب الشركات
- المورد من الدرجة الثانية
- المورد للحكومة
- أخرى

الجزء الأول: معلومات عامة عن المستجيب

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☒ ƱƟƖƪƃ ƣ ĬƳƍƑƜƪƃ ƅƑƥƃƿƪƃ) ƅƑ ƅƑƢ ƋƎƉ ƅƒƜƪƃ):....................................

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لذا يسر الباحثة أن تضع بين أيديكم أداة الأستقصاء (الاستبانة) المرفقة، آملا التكرم بالاجابة عن جميع فقراتها بوضع اشارة (X) إزاء الدرجة التي تمثل إجابة شركتكم عن كل فقرة من فقراتها.علماً بأن إجابتكم ستعامل بسرية تامة ولن تستعمل الا أغراض البحث العلمي.

شاكراً لكم صدق تعاونكم ومساهمتكم في استكمال هذا الاستقصاء.

الباحثة:
دعاء سميح الزقايبه

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(14001 [illegible])

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10	إعادة استخدام الأجزاء المكونة للمواد أو المنتجات						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible] (14001 [illegible])

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10	النسبة المئوية للأجزاء المكونة للمواد أو المنتجات التي تم إعادة استخدامها						
[illegible]	[illegible]	[illegible] %0	[illegible] %20-1	[illegible] %40-21	[illegible] %60-41	[illegible] %80-61	[illegible] %100-81
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Abbreviations:

Abbreviations #	Abbreviations	Term
1	EMS	Environmental Management System
2	KPIs	Key Performance Indicators
3	GOAs	Green Operations Actions
3	PIs	Performance indicators
4	GDP	Gross Domestic Product
5	GMS	Green Manufacturing Strategy
6	GSCMPs	Green Supply Chain Practices
7	SMEs	Small Medium Enterprises
8	CEP	corporate environmental performance
9	GSCM	Green Supply Chain Management
10	CFs	Critical Factors
11	IOPs	Indicators of Organizational Performance

Acronyms

Acronyms #	Acronyms	Term
1	IC	Internal commitment
2	GP	Green purchasing
3	CC	Customer cooperation with environmental consideration
3	(E-D&P)	Eco-design and packaging
4	IR	Investment recovery
5	(Ds&Te)	Distribution strategies and transportation execution
6	RL	Reverse logistics
7	W&GB	Warehousing and green building
8	EP	Environmental performance
9	OP	Operational Performance
10	EP	Economic Performance

Terms:

Terms #	Term	
1	ISO14000	ISO14001
2	Strategic groups	Agile , Care-taker, and Lean environment
3	Cluster(1)	Care-taker environment
3	Cluster(2)	Agile environment
4	Cluster(3)	Lean environment

Appendix B

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[illegible] 103 [illegible] 3 [illegible] 5 [illegible] 27 [illegible]

K-mean clustering [illegible] (analysis) [illegible] (Average) [illegible]

. (Average) [illegible]

[illegible] Care-taker) (Agile environment) [illegible] (14000 [illegible])

الكلمات المفتاحية: شهادة الايزو 14000، إدارة الأنظمة البيئية، استراتيجيات التصنيع الخضراء، مؤشرات الأداء الأساسية، الأنشطة الخضراء، مؤشرات الأداء المتحقق.

بسم الله الرحمن الرحيم



جامعة اليرموك
YARMOUK UNIVERSITY

كلية الاقتصاد والعلوم الادارية
قسم ادارة الأعمال

الرقم: ك ق/50/107/ ٢٩٧
التاريخ: /ذو الحجة/1434 هـ
الموافق: ٨ /تشرين اول/2013 م

لمـن يهمـه الأمـــــر

الموضوع:تسهيل مهمة

تحية طيبة وبعد،

ارجو العلم بأن طالبة الماجستير دعاء سميح الزقايبة ورقمها الجامعي (2011360080) تقوم بإجراء دراسة ميدانية استكمالا لمتطلبات رسالتها للماجستير والتي هي بعنوان :

تقييم استراتيجيات التصنيع الخضراء للمنظمات الحاصلة على شهادة الجودة (الأيزو 14000) في الأردن "

لذا يرجى الموافقة على تسهيل مهمتها وتقديم المعلومات التي تحتاجها لاكمال الدراسة. علماً بأن المعلومات ستعامل بمنتهى السرية وستستخدم لأغراض البحث العلمي فقط.

وتفضلوا بقبول فائق الاحترام والتقدير،،

المشـــــرف

د. يـــزن مقـــــدادي

هاتف: ٩٦٢-٢-٧٢٧١١٠٠ فاكس: ٩٦٢-٢-٧٢٧٤٧٢٥ اربد-الأردن

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